World War II Battlefield Communications

GORDON L. ROTTMAN

ILLUSTRATED BY PETER DENNIS

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Consultant editor Martin Windrow

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Abbreviations

AM	amplitude modulated
CP	command post
CW	continuous wave (i.e. Morse code communication)
FM	frequency modulated
GMT	Greenwich Mean Time
HQ	headquarters
IDL	International Date Line
MC	megacycle
Mhz	megahertz
OP	observation post
RDF	radio direction finding(er)
SCR-	Signal Corps Radio (US)
WS	wireless set (UK)
XO	executive officer (second-in-command)

Front cover: Eastern Front, January 1944: a forward observer for an artillery battery of PzGren Div "Grossdeutschland" using a *Fernsprecher 33* field telephone. (Sipho)

DEDICATION

This book is dedicated to the memory of William L. "Bill" Howard, LTC, US Army, Ret (July 31, 1941–May 7, 2008) who established the William L. Howard Ordnance Technical Intelligence Museum, Largo, FL (presently closed, but to be reopened). Bill possessed a love for the study and collecting of communications equipment, and freely shared his knowledge with others. The museum's still-active website is: http://www.wlhoward.com/

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ARTIST'S NOTE

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Imperial War Museum www.iwm.org.uk

Differences in US & British terminology

American	*British*
Signal Corps (SC)	Royal Corps of Signals (R Sigs)
radio (key) *or* radio-telegraph	wireless-telegraphy (W/T)
radio *or* telephone (voice)	wireless-telephony (R/T)
radio-teletype	teleprinter
spiral-four cable	quad cable
antenna	aerial
vacuum tube	valve
simplex	superpose
field wire	cable or line
wire reel	cable drum
communication officer	signal officer
message center	signal office
messenger	runner
courier	dispatch rider (D/R, "Don-R")

Frequency measurement

During World War II most countries used megacycles (MC) for frequency measurement; in 1960 this standard was changed to megahertz (MHz). British and Empire/Commonwealth forces measured wavelength in meters.

300,000 divided by kilocycles = meters
300,000 divided by meters = kilocycles

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WORLD WAR II BATTLEFIELD COMMUNICATIONS

INTRODUCTION

Military communications – ("commo" or "comms"), signals ("sigs"), or in the German term *Nachrichten* – describes a wide range of means to transmit orders, information, and requests between headquarters and units. The varied means to accomplish this included radios, field telephones, telegraph, teletype, pyrotechnic signal flares, colored smoke signals, signal flags, ground–air signal panels, heliographs, signal lamps, messengers (human or animal), and more.

The services provided by an army's communications branch personnel were equally widely varied. Besides operating all of these varied means they had to develop, maintain and repair equipment; provide communications equipment, supplies and related items to other organizations and units; lay

The German *Tornister Funkgerät* "*Cäsar*" and "*Dora*" models were externally similar and both man-portable, the main difference being in frequency coverage and weight. This set, mounted in a Kfz 2 *Nachrichtenkraftwagen* (signals car) by an artillery unit of 17. Panzer Division, is probably a 20kg (44lb)Torn.Fu.c rather than a 17kg (37.5lb) Torn.Fu.d2.

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In the 1940s the repairing of communications equipment was a constant demand upon signals units. Even in the US Army units did not have spare radios, and the relatively fragile and technically immature sets had to be "turned around" in the repair shops as quickly as possible.

and repair telephone and telegraph lines; provide encryption and decryption services; allocate and manage radio frequencies, call signs and codeword systems; reduce or counter enemy intercept and jamming efforts; attempt to intercept, monitor and jam enemy communications traffic; monitor their own communications to ensure security compliance, and develop and implement security measures; operate radar, provide radio direction-finding, and establish and operate radio beacons and navigation guidance systems for aircraft. Some armies' signals services had additional responsibilities such as providing still and motion-picture photography, and producing training, motivational, and propaganda films. Some also broadcast radio news and entertainment programs, and published newspapers and other information publications.

* * *

Great strides had been made in radio and other means of communications through the 1930s. On the eve of World War II many researchers felt that tactical radios could not be much further improved, and mass production commenced. It was the first time that tactical units (i.e. regiments and below) were provided with meaningful numbers of portable radios, but even so the numbers proved to be inadequate. In light of combat losses and the armies' massive expansion, even the US Army – often described as possessing extravagant quantities of radios, and supplying huge amounts of equipment to allies – did not catch up with actual need until 1944.

Allied countries worked on developing improved tactical radios to make them more reliable and robust for field use, lighter, more compact and transportable, longer-ranged, and capable of better reception. The Axis nations, strapped for materials and resources and facing multiple demands for what they had, were mainly forced to make do with existing systems, and could not even replace losses.

Signal troops operated at all levels, although – depending on the army – communicators in tactical units were not necessarily assigned from the signals service, but belonged to their unit's parent branch such as infantry, armor, or artillery. The focus of this book is on tactical communications at infantry regiment/brigade level and below.

Correcting some common misconceptions

* The voice range of the great majority of battlefield radios was very limited.
* AM and FM radios cannot communicate with one another.
* When communicating between two radios only one operator can speak at a time – the other cannot interrupt.
* Listening in on radio and wire communications at small-unit level obtained little usable intelligence. With radio it was extremely difficult to determine even where the transmitting unit was. Any information obtained was extremely perishable owing to the rapidly changing tactical situation, and of little use unless acted upon immediately.
* Long-range communications such as by secret agents, coastwatchers, long-range reconnaissance aircraft, etc., could not be conducted by voice – they had to use Morse code.
* Radio direction finders (RDF) were extremely inaccurate, and even if they were able to "triangulate" a signal they might be hundreds if not thousands of meters off; this was dependent not only on operator proficiency and equipment accuracy, but on signal strength, distance from the signal, and atmospheric interference.

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MEANS OF TACTICAL COMMUNICATION

FIELD TELEPHONES

Field telephones, wire communications, or "land-lines" were the principal means of tactical communication in all armies. Most field telephones of the era were relatively heavy box-like affairs with a handset containing the mouthpiece and earpiece (see Plate A). Most operated with a ringing circuit activated by turning a small crank, which rang a ringer on the other end or alerted a switchboard, and usually a light as well (the ringer could be cut off for silence). To speak, a push-to-talk button was pressed on the handset, which was powered by a battery. Most phones used a two-line wire. The Germans used a ground (or earth) return system, with a great saving in materials; this required only a single-strand line and a short wire connected to a steel stake driven into the ground. The disadvantage was that the enemy could easily tap in by simply driving two stakes attached to a telephone into the ground in the general area.

Another type was the sound-powered telephone. These lightweight sets, with a range of no more than a quarter-mile (440 yards) were suited for use within a company – e.g. for contact with an observation post – or to link the gun positions within a battery. When the mouthpiece was spoken into a diaphragm caused a coil to vibrate and transmit sound through the wire, and a coil in the receiving phone was vibrated by a magnetic field to produce sound.

The advantages of land-line telephones were significant. They had much longer ranges than radios; they were more reliable; sound quality was relatively good so long as distances were not too great, and amplifiers could be integrated into the system to boost signal strength over longer distances. A given unit could talk to a subunit in another unit by going through the battalion switchboards, and the connection could be made in just a couple of minutes. With radio it was a different matter. The sending unit would have to have access to the other unit's radio frequency and callsign. Changing

A German wire party lays a field telephone land-line parallel with a muddy road on the Eastern Front; the lead man carries a "wire pike," used to string cable in trees. Wire was more likely to be cut by vehicles if it was laid on the ground than by artillery fragments if it was suspended. (Stavka/Nik Cornish WH849)

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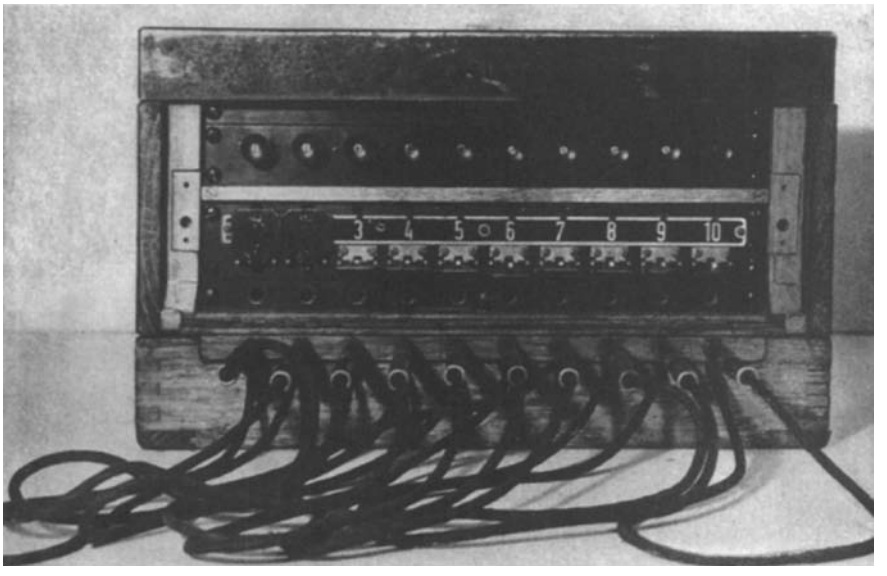

The German small switchboard for ten lines (*kleiner Klappenschrank zu 10 Leitungen*) required an extra linked *Feldfernsprecher 33* field telephone to operate it.

frequencies might require precise tuning and even antenna changes, and during such communication the operator would be "off net" and unable to communicate within his own unit's net. With a telephone the switchboard operator could break in and let the unit know it had an immediate call.

Telephone traffic was more difficult to intercept than radio transmissions, although this could be accomplished by infiltrating into enemy territory and tapping into the line. Phones were not appreciably affected by atmospheric conditions and weather. If existing commercial phone lines had not been badly damaged, then, with the cooperation of local civilians, they could be tapped into and used by the military (although, of course, the lines had to be cut where they ran into enemy territory).

When laying telephone wire (see Plate H), virtually all armies followed the practice of the higher-echelon unit laying wire to its subordinate units and so on down the line. Typical practice when connecting to adjacent units, i.e., units on the flank, was for a unit to make contact with the unit to their right. This was usually only practiced at regimental level: for example, adjacent battalions from two different regiments did not link up directly by wire, but the two regimental headquarters did, and thus the battalions could be connected through adjacent switchboards. This was not as inefficient as one might imagine, but ensured an organized and efficient communications system; if battalions from different regiments attempted to execute actions without coordination with and approval from their parent regiments, it could lead to a great deal of dangerous confusion.

Telephones naturally had their limitations, too. It required a good deal of time and wire for a unit to establish a complete wire system. This involved laying wire to all subunits, alternate lines, and lateral connections, testing the lines, and verifying that all stations were on line. Crucially, maintaining the wire system required ceaseless work. The miles of line were constantly being cut by artillery and mortar fire, enemy infiltrators and patrols, hostile civilians, weather damage (high winds, fallen trees, flooding), and – the worst culprit of all – friendly vehicle traffic. In the Pacific amphibian tractors (amtracs), extensively used in rear areas to haul supplies, were notorious for cutting wires. Patrols infiltrating behind enemy lines routinely cut every

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Red Army wiremen stringing a field telephone line across a flooded stream. When doing this the bare wire at the end had to be kept out of the water to prevent it shorting out, and the line would later have to be anchored across the bottom to prevent floating logs and debris from snagging and breaking it. The field telephone carried slung by the foreground soldier appears to be an F-41. Wiremen of all armies often checked the telephone connection while laying a line, to ensure that no breaks had occurred while it was being laid and that reception was still acceptable, which was a concern with long lines. (Stavka/Nik Cornish A41)

telephone line they encountered, often pulling down lengthy sections; they might also ambush wire-repair parties. In rough terrain and at night it was so difficult to locate breaks that it was often easier to lay a new line. It was preferred that wire was strung on poles or trees to avoid vehicle traffic, but that made it more susceptible to artillery and required much more time. Wiremen might press wire down into muddy ground in an effort to protect it; sometimes special vehicle-pulled plows were used to cut a groove and bury wire, but these were limited to the higher echelons. In desert and on large plains such as the Russian steppes there were no convenient trees, and wooden poles, if available at all, had to be trucked in over long distances; for example, the Marines arrived on treeless Iwo Jima with thousands of telephone poles sent from Australia.

Another issue was the amount of wire necessary. The Germans and Japanese often experienced shortages, as did the Allies at times. During rapid advances and withdrawals wire often had to be left behind, and would be recovered by the other side. There were several types of telephone wire available. Frontline units used lightweight "assault" wire; easier to carry and lay, it offered shorter range. Heavier duty wires were available for rear area units, and there was also telephone cable capable of transmitting multiple simultaneous telephone and telegraph transmissions.

Telephones operated in one of two manners: "point-to-point" or "local battery" was when two phones were directly linked together; a "common battery" system was when a number of telephones were linked to a switchboard, as found at battalion level and above. Switchboards signaled incoming calls on specific lines, and the operator could connect them with any other phone. Common switchboards at regimental levels and below included six-, 10-, 12- and 20-line models. The better models had integral earphones and mouthpieces (an "operator's pack"); Soviet, German, and Japanese switchboards, especially smaller models, required an extra standard telephone to be attached for the operator.

While telephones were ideal in the defense, in other situations they lost some of their utility. During the march to the front and other displacements, units naturally lost the use of telephones, and a telephone net was established as quickly as possible when units occupied their new positions. They were not without their uses in the offense, however. Reserve and supporting units and artillery stayed on the net until relocating forward. Advancing units laid wire behind them, and maintained continuous contact down to company level. It was not uncommon for short-range patrols operating forward of the front line to lay wire to report back information immediately.

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RADIOS

Radio or "wireless" had been used to a limited extent in World War I, but unlike the rapid advances made in aircraft and motorized vehicles, radio theory was not fully understood and development was slow. Voice radio was introduced in the 1920s and spread rapidly; previously wireless telegraphy had been used. Between the wars radios were improved to the point that they were made light and rugged enough to be transported by soldiers or carried in vehicles. Many refinements were introduced, but there were still serious limitations. Period radios, including man-portable models, were heavy; some had to be broken down into two or more loads, with the receiver and transmitter carried separately from batteries or a hand-cranked power generator, antennas, and accessories. Radios were temperamental, required precise frequency tuning and calibration, and still demanded gentle handing owing to their soldered connections and fragile glass vacuum tubes.

There were two types of radios. Most were **amplitude modulated (AM).** These achieved long range by voice, but when using continuous wave (CW) transmission – that is, key-tapping Morse code – they could reach even longer ranges. They used skip-wave transmissions – radio waves reflecting off the ionosphere. AM voice signals were directly mapped into changes in the radio signal's amplitude. AM radios could not be operated on the move, but had to be set up, with a long wire antenna strung in a certain direction and its length adjusted for the frequency used. The message was transmitted while the radio was powered by a hand-cranked generator continuously recharging the heavy battery. All of this preparation and set-up was a time-consuming process. Voice transmissions had range limitations and were not always that clear, picking up much static, and the receiving station might not receive the transmission due to interference from other stations or atmospheric conditions. AM radios were not conducive to fast-moving situations, and were not as effective when mounted in vehicles; mechanical operations, as well as the vehicle's electrical system (batteries, sparkplugs, lights), created interference even with shielding. One advantage of AM radios was that with

Mindoro, Philippines, 1945: a US Army command post operating an SCR-284 radio, the common AM set for communications between battalion and regiment. The house on stilts provides shelter from the rain and concealment from over-flying Japanese fighters. (Keystone/Getty Images)

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fine tuning they could pick up multiple transmissions on the same band. This allowed frequencies close to the main one to be monitored, so an operator could sometimes listen in on other radio nets within his unit.

Frequency modulated (**FM**) radios came into wider use as the war progressed. These were lighter and more compact, and could be man-packed in a single unit or even hand-held –"handie-talkies." However, FM radios were capable only of line-of-sight communication; this does not mean that the two operators had to be able to see one another, but that intervening hills or ridges could block signals. On FM radios the voice signal was mapped into changes of frequency from the radio carrier frequency; this helped reduce interference. When several different signals were being transmitted on one band FM radios could only pick up the strongest and the others were blocked. Contrary to what is often depicted in movies, these radios were very short-ranged; for example, the American SCR-300 "walkie-talkie" (see Plate B) had a range of only about 3 miles. They relied on batteries, which were heavy, and were expended at a high rate. Their frequency coverage was limited. More powerful vehicle-mounted FM radios might have a longer range when powered off the vehicle electrical system.

VISUAL SIGNALS

Visual signals included colored flares and smoke, signal flags and ground panels, and signal lights. They had the disadvantage that if they could be seen

Tacloban, Leyte Island, Philippines, 1944: units often modified vehicles to serve as mobile communications centers. Here a DUKW amphibious truck has been fitted with a communication shelter. Two DR-8 wire reels are mounted on the left stern, and on the ground 12-volt batteries power a dismounted radio set. (© Bettmann/Corbis)

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by the intended recipient they could also be seen by the enemy. While the enemy would not usually know the meaning of the signal, it did reveal the location of the sender; however, there were many circumstances in which this was acceptable or inconsequential.

Marines advance over a ridge top on Okinawa, 1945. The radio operator to the left packs an SCR-300, and is armed with an M1 carbine; beyond him, note the marine carrying a DR-4 reel with a ¼-mile of light "assault wire." These men are probably part of a battalion headquarters. (© Corbis)

Pyrotechnics: flare and smoke signals

Very pistols and similar flare guns, or pyrotechnic launchers, dischargers, and projectors have long been used by the armed forces and civilians to signal distress situations, to mark locations, and to signal orders or actions. In World War II these were generally single-shot, breech-loading handguns or reloadable tube-like projectors, although there were a few double- and even triple-barrel models (see Plate D).[1]

These launched colored flares (night or day) or smoke signals (day). Common colors were red, white, green, amber, and blue, which might be single free-falling flares, flare clusters, or parachute-suspended flares. Smoke cartridges were found in red, orange, white, green, yellow, violet (purple), and blue. These either left a smoke trail behind them (smoke streamer or smoke tracer), to make them easier to see when marking targets and making a signal, or were suspended from a parachute for greater duration. Of course, not all of these colors were used by any given country. Red and orange were often used as a distress or danger warning but could be used for other purposes. The Germans, for example, often used red to warn of the presence of enemy tanks, and orange to mark their own troop locations. Multiple-color flares were sometimes used; the British commonly used three-star combination cartridges of red-white-red and green-red-green, and the Germans made limited use of a special cartridge that could be set to eject six different combinations of three, four, or six red and green stars. The US used red, green, and amber aircraft signals provided in single and double stars, and a double star with a red tracer. While flare projectors and pistols remained in use, the US and British both also employed rifle-grenade launchers to project pyrotechnic signals. The US used not only rifle-launched signals, but provided tailboom adapters for fitting to colored smoke hand grenades.

Pyrotechnics could be used for a wide variety of preplanned signals. They were most often used to signal the launching of an attack, the securing of an objective, and instructions to shift or cease fire, withdraw, and so forth:

1 For some inexplicable reason many people assume that the Very (or, incorrectly, Verey) pistol is of British origin. This flare pistol and its cartridges were developed in 1877 by a US Navy officer, Lt Edward W. Very (1847–1910). Awkward and unreliable fireworks-like signal skyrockets had been used for night signaling between ships from the late 1700s; the first breech-loading Very guns used cartridges based on 10-gauge shotgun shells to launch variously colored flares or "stars." They have since been made in a number of calibers by many countries, to include 12-gauge (.729in = 18.53mm), 10-gauge (.775in = 19.69mm, aka 20mm), 1in (26.5mm, aka 27mm), 35mm, 1.5in (aka 37mm), and 40mm.

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Engaged by enemy forces/enemy is attacking
Commencing or order to initiate an attack or other specified action
Lift or shift fires (different signals might be required for these two actions)
Repeat last fire mission/air strike
Mark friendly positions for friendly aircraft
Enemy air defense fires present (to warn friendly aircraft)
Enemy tanks or antiarmor weapons present (to warn friendly armor)
Friendly tanks going into action (to warn off friendly aircraft)
Objective secured or a specified action has been completed
Friendly patrol returning
Patrol in trouble
Withdraw or disengage
Friendly fire falling within our position (check fire)
Cease fire

The use of pyrotechnic signals had to be kept simple, since too many different signal meanings and overuse of multiple colors in sequence could lead to confusion. On Pacific islands on which two or more Marine divisions were operating each division was assigned a different color to identify their locations. Other factors needed to be considered, especially when using smoke. Certain colors – e.g. violet – might be difficult to identify from the air at dusk or dawn. Colors had to contrast with the background; for example, green would be unacceptable in forest or grasslands, white on snow, or yellow in desert or dried-grass plains.

The Germans and Japanese frequently attempted to employ colored smoke or flares to confuse Allied signaling and marking efforts. Soldiers learned to be able to differentiate between the exact shade and density of their flare colors and smoke and those of the enemy. During the 1942 St Nazaire raid the British fired a red flare as the expected recognition signal when the attacking flotilla entered the channel. This turned out to be a flare intended to be fired from an aircraft and not on the surface; in fact, however, it was not the trajectory that alerted the Germans, but the slightly different shade of red.

Oddly, Red Army reconnaissance units were officially authorized only few radios, although laying wire for field telephones was often impractical during their missions. This flaw in the system was understood by many officers lower down the chain of command, and if sufficient of the lighter-weight radio sets were available locally they were often passed to reconnaissance units. (Stavka/Nik Cornish K231)

Tracer fire from machine guns and other small arms was used as a simple form of signaling and to mark targets for supporting weapons. At predetermined times of night a machine gun might fire a stream of tracers toward a particular hill to help a patrol to keep oriented on it, or a tracer stream might be fired almost straight up to provide a landmark for patrols.

Smoke grenades and candles

Colored smoke grenades and candles were used by ground troops to signal to aircraft and other ground elements, and to mark positions; a given army might use five to eight colors. Combinations of colors were sometimes used to provide additional signal meanings, but usually no more than two at a time so as to prevent confusion. An Allied intelligence report described the German use of these smoke candles in North Africa, singly or in combinations (the Italians in this theater used the same system):

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Color(s)	Meaning
Orange	Friendly troops here (orange was also used for distress signals)
Orange-red	We are isolated/cut off/the enemy is behind us
Orange-green	Repeat your attack
Green	Increase range of action – we are advancing/attacking/making contact
Red	The enemy is attacking/infiltrating/penetrating
Red-green	The enemy is attacking/encircling on our right
Red-white	The enemy is attacking/encircling on our left
Violet	Enemy tanks ahead
Violet-red	Enemy tanks in our rear
Violet-green	Enemy tanks to our right
Violet-white	Enemy tanks to our left
Violet-orange	Friendly tanks are going into action (to warn off friendly aircraft)

In other theaters the Germans used red smoke as a standard ground-to-ground warning for "beware of enemy antitank weapons," and blue or violet to warn of "enemy tanks present." Orange always indicated friendly troop locations, and white marked enemy (i.e. Allied) targets.

Signal flags

Single-flag and two-flag signaling systems have been used for centuries; paddles with round or square shapes on handles, and lights, were also used. The US Army used the single-flag "wig-wag" system dating from the 1850s and based on Morse code dots and dashes (see Plate E). Two 2ft-square flags were provided, one with a red background and the other white, with an 8in-square center of the opposing color. Only one flag was used at a time, selected for its contrast with the terrain background. More widely used were pairs of semaphore flags, held in different positions for each letter or number. Diagonally divided 18in-square white-and-blue flags were used on land, and yellow-and-red or white-and-red flags both at sea and often ashore. The two US "wig-wag" flags could also be used for semaphore. The British traditionally used a pair of solid blue and striped white-blue-white semaphore flags, the Japanese a pair of solid red and white flags.

A German Torn.Fu.b1 (or similar variant) in a winter fixed defensive line on the Eastern Front. This set is fitted with a long rod antenna; for longer-range transmissions a long wire antenna could be rigged, attached to a high pole or tree. A Soviet 7.62mm ammunition box can be seen behind the operator's overboots.

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Another flag system was used by tankers and other vehicle crews. The US, British, Soviet and German armies used a three-flag set of yellow, green, and red (the US three-flag set was the M-132; there was also a one-flag M-133 set with a 19in-square orange flag). Flag signals were given in accordance with a code, the meaning of any signal depending on the color of the flag and whether the flag was held still or moved in a particular manner. Flags were soon discarded as being too conspicuous, and replaced by hand signals. The Japanese used an elaborate flag system with different colored and patterned red-and-white and blue-and-white triangular flags to relay orders and actions, which also identified the echelon of the commander making the signal.

Flag signals had their own disadvantages. One subunit might see another's signal and, even with command flags displayed, mistakenly believe it was meant for them; or the flags could be obscured by dust, smoke, fog, and rain (arm and hand signals were naturally even more difficult to see in low visibility). Flags cannot be used at night, so a system of appropriately colored flashlights was used. The main problem with all these visual communications was that individual tank commanders had to be constantly attentive to their subunit leader's tank, at the expense of watching the terrain, detecting enemy threats and targets, watching other tanks in the subunit to maintain formation, and directing their crew members.

Marker panels

These were mainly used for ground-to-air signaling to mark positions and identify vehicles. Panels were of two types: either long and narrow panels for physically forming letters with two or more panels; or square with contrasting colors on opposite sides, so one or more corners would be folded over onto the panel with the point of the corner at the center, each pattern having a prearranged meaning. The long, narrow panels also had contrasting colors on the two sides so they could be seen against different backgrounds. Besides prearranged signals, panels were often used to indicate unit front lines to friendly aircraft. This was typically done only upon request or at a prearranged time; panels were of course not left displayed in the event enemy aircraft appeared. Such panels would be displayed on either flank of the unit and possibly in the center of its sector or at its CP.

A

FIELD TELEPHONES

The most reliable and secure means of tactical communications available, field telephones were widely used by all armies. The cases might be of wood, various metals, or synthetic materials such as Bakelite; most had a canvas or leather carrying bag.

(1) The US Army's EE-8 – also supplied in large numbers to the USSR – is illustrated here in a leather case. Pre-war and early-war EE-8s had an aluminum case with a leather carrier (measuring 9⅜in × 7¼in × 3½in). Leather did not hold up well in the tropics, so canvas was later substituted. The EE-8-A had a slightly larger aluminum case (9 ⅜in × 7 ¹¹⁄₁₆in × 3½in) with a canvas carrier. The EE-8-B also had a steel case without a carrier, but with a treated leather top lid. There were other differences, including improved handsets. The infantry battalion had eight EE-8s.

(2) The simple US Army TS-10 handset was a sound-powered phone. Each infantry company had two of these.

(3) The US Marine Corps initially used the sound-powered Type MCT-1 alert telephone, before acquiring the EE-8. Note the USMC's forest-green paint finish.

(4) At small-unit level the British and Commonwealth armies used the Type D Mk V, which had an integral Morse code key.

(5) The British Mk III Fullerphone was particularly useful for long-range wire communications by Morse code.

(6) The Soviet Union began the war with a miscellany of foreign-made or copied field telephones, before settling on this TAI-43 in 1943. Earlier types included the UNA-I-42, UNA-F-42, and TABIP-2.

(7) The German *Feldfernsprecher 33* (literally, "field far-speaker") was a ground-return phone.

(8) The Japanese Type 92 (1932) was unique in that many had handsets and other components made from zinc.

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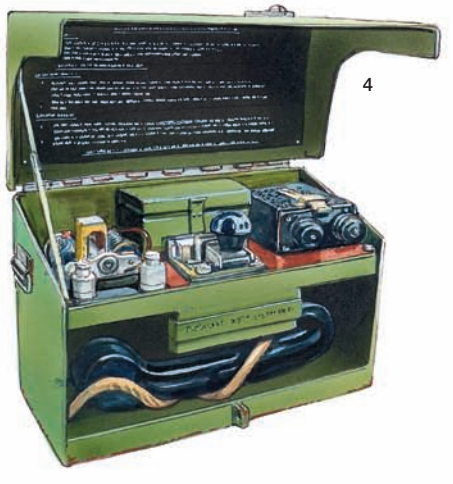

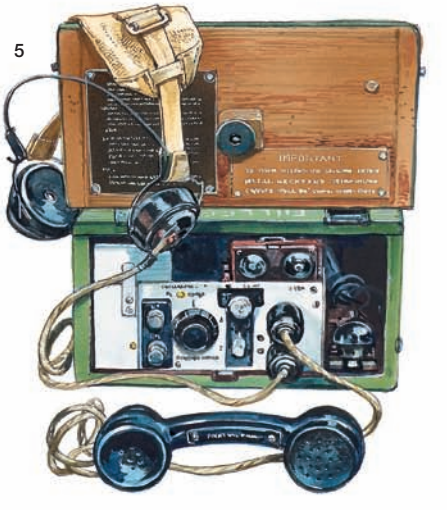

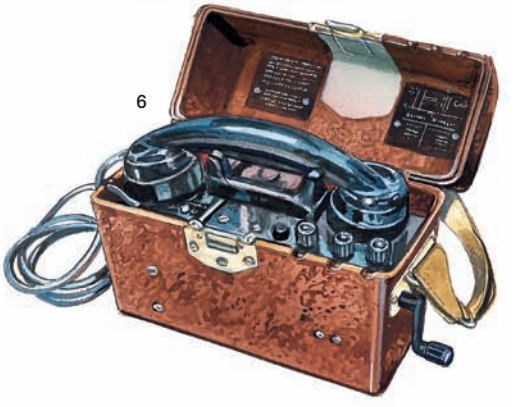

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Although it is difficult to make out under the *Zeltbahn*, this *Funker* (signaller) is operating a Torn.Fu.g "Gustav" with a whip antenna. This model could be carried by one man, and was used by Panzergrenadiers to maintain contact with their halftracks when dismounted. The SdKfz251/1 and most other halftrack variants mounted an Fu 7 radio, as used in many tanks.

The US used the AP-50 marker panel set, which consisted of two canvas bags each containing two 12ft × 30.5in panels, in red (cerise-pinkish tint) or yellow (light orange), with white on the reverse of all. A single bag was called an AP-30 set. In late 1944 the AL-140 panel set was issued; rather than panels carried in a bag, this had either a red or a yellow panel attached to a canvas cover which, when rolled up, served as the carrying bag.[2]

The British used the same panel sets as the US; the Germans displayed large national flags on upper surfaces of tanks and other vehicles to identify them to aircraft.

Another means of using panels was found in the Pacific. To mark the progress of advancing units along an island's shore, panels were hung in trees so that fire-support ships could identify the front line. In November 1943 Apamama atoll, 76 miles southeast of Tarawa, was secured by Amphibious Reconnaissance Company, V Amphibious Corps, who were delivered by submarine and engaged a Japanese force. Unable to maintain radio contact with the submarine, which provided fire support, they marked their advance by hanging colored panels.

The Japanese habitually used small national flags to mark their locations, and also a complex system of long white panels laid out in a T-shape to mark the flanks and center of positions. Narrower red, black, or blue panels were laid on the white so they would appear white-edged, and one or two small white triangular panels positioned a particular way in relation to the "T" indicated the specific unit down to battalion level. For example, a divisional reconnaissance regiment had blue panels laid atop the white, with a triangle on the bottom end of the "T" and another angled off the right-hand end of the crossbar. The impracticability of such complex systems under battle conditions hardly needs to be emphasized.

Signal lights

The hand-held Aldis lamp ("blinker light") or flashlights were sometimes used to transmit Morse code, either using a shutter system or simply by turning the light rapidly on and off. Another device was the US SE-11 signal set with an M-277 "signal gun" on a lightweight tripod (see Plate E). Blinker-light systems employing larger lamps were used aboard ships, but

2 See also Elite 117: *US World War II Amphibious Tactics: Pacific Theater*. The US and British forces also used large rectangular panels set on two poles to mark the flanks and center of landing beaches. These were the same color as the beach identification (red, blue, green, yellow, orange, white), and the number of panels indicated the beach number, e.g. beach Blue 2 had two horizontal blue panels. There were also square panels in multi-colors or bearing symbols to designate specific landing sites for tracked and wheeled vehicles, or for different classes of supplies (rations, ammunition, fuel, etc.) At night the appropriate colored lights would be displayed instead.

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handheld models were used ashore. Both the Germans and Japanese used very elaborate tripod-mounted signal lamps.

A little-used but still-effective light signal was the venerable heliograph. This was a small mirror mounted on a tripod and fitted with a keying device that slightly tilted the mirror to transmit flashes of sunlight using Morse code. If the sun was behind the mirror a second mirror was attached to reflect light onto the main mirror. While detectable by the enemy, if emplaced correctly using terrain and vegetation to mask the devices they had a "low probability of intercept." By establishing relay sites communications could be made over distances of hundreds of miles, much further than tactical radios. A single heliograph was readable over 30–40 miles under ideal conditions and with careful positioning; during overcast conditions and at night the mirror was illuminated by a small lamp. Heliographs remained in use by the British, Australians, and Soviets into the 1960s.

Within subunits, flashlights (hand torches) were used for simple signaling, sometimes in conjunction with arm and hand signals, or in lieu of vehicle signal flags at night. Military flashlights often had colored lens filters. The German field pocket lamp (*Feldtaschenlampe*) had three sliding filters in blue, green and red; the US Army TL-122 flashlight lacked colored filters until the 1944 TL-122D, which had red and blue.

Arm and hand signals

A series of arm and hand gestures were used by platoon and squad leaders signaling to their men, who could also use response and confirmation signals. Variations of such signals were used by dismounted troops and those mounted in vehicles (halftracks, trucks). Such signals included: Assemble on me; Enemy in specified direction; Move in specified direction; Change to specified movement formation; Take cover; Halt; Advance; Withdraw; We are here; Passable route; Dig in; Send ammunition; Air/Gas alarm; Open fire; Cease fire, etc. Some signals employed an implement such as an entrenching tool to signal "dig in," holding up an ammunition can to request more ammo, or a gasmask to order that they be donned. (The more elaborate hand signals given between individuals in some modern movies were seldom used. These evolved in Vietnam and other modern conflicts, or were developed by SWAT teams.)

MESSENGERS

Messengers (British infantry, runners; in Russian, *peshii*; in German, *Melder*; in Japanese, *denrei*) were an important means of communication. Many armies designated one or two messengers in the rifle platoon headquarters, with up to three in the company headquarters. With two messengers in the platoon headquarters, the concept was for one to remain with the leader and the other to be dispatched to the company headquarters after the platoon's position was established. This was the US, Soviet, and German practice. The Japanese had up to eight messengers in the company headquarters, some of whom were detailed out to platoons. British and Commonwealth platoon commanders had a single batman/runner, though sometimes a second was provided for contact with the sections (squads); company headquarters had three runners.

Platoon messengers were not normally intended for intra-platoon communications – that was accomplished by voice and arm/ hand signals – but rather to relay messages between the platoon and company headquarters.

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Britain, spring 1944: during rehearsals for their landing on Omaha Beach, members of the US Navy 7th Beach Battalion pose as if establishing a signal station, with both old and new equipment. The kneeling sailor (right) has an SCR-536, but on the tripod (center) is a portable blinker light, and the man standing to the left of this holds yellow-and-red semaphore flags. Beach battalions controlled and supported landing craft operations, managing the delivery of troops, equipment, and supplies into the beachhead. (Photo by Galerie Bilderwelt/Getty Images)

Ideally the same messengers would travel between the company and their own platoon, but the necessities of combat meant they could be sent to any other platoon. Losses often meant that messengers found themselves as riflemen, and another man might then be detailed as a messenger – but not just any other man. The task required a smart, quick-thinking, reliable soldier. He had to be able to orient on terrain and find his own way, since he never had a map, and he needed the determination to make it to his destination as quickly as possible regardless of difficulties. However, the distances were seldom great: company frontages were no more than 150 yards in the defense and less in the attack, and the company CP was just to the rear of if not directly in the front line, near the center of the company position; a messenger seldom had to travel more than half a football field. They might also be used to coordinate between adjacent platoons, especially if a gap developed.

When a messenger was given a verbal message he repeated it back aloud to fix it in his mind. He was to ask questions if he was not entirely clear on details – a young platoon leader could be excitable in combat. Oral messages had to be brief, usually no more than a sentence or two. Any message involving numbers – e.g. grid coordinates, ammunition requests, and times – had to be written down. Messages on notepad pages or message forms needed to be clear, concise, and as brief as possible (a piece of cardboard ration carton also made a good message blank.) Paper messages needed to be protected from water and sweat, and it was found best to use pencil, as ink smudged when wet. Other paper items included map overlays (tracing paper), sketch maps

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annotated with information, terrain sketches, unit fire-plan and obstacle-plan sketches, and planned patrol routes. The messenger oriented himself on the ground, fixed any landmarks, and selected a concealed route. A lone individual darting towards or approaching from the rear would immediately draw fire, as the enemy strove to halt messengers. En route the runner would be on the lookout for any information of value, and upon arrival he would report this when delivering his message to the CO or the message center. He would ask if there was any responding message, and obtain acknowledgement, a reply or any different message to carry back. He might also be required to pick up ammunition or other items for his platoon before returning. Upon return he would report to the platoon leader that he had accomplished his mission, and relay any messages and information of use.

Communications between company and battalion were normally made by telephone or occasionally radio, but in fast-moving situations, when wires might be cut or radios temperamental, messengers had to be used. The time and distance factors were longer, but it was a safer job when further to the rear, and if he got lost the messenger could find rear-area personnel to set him straight. The Japanese sometimes established long-range foot and bicycle messengers with relay posts. The Germans provided battalion and higher unit messengers with bicycles or motorcycles; early in the war they used horses, but these fell out of use. Motorcycles had their limitations, being useless in mud, sand, snow, dense forests, and extremely broken ground. In snow conditions ski-equipped couriers were used by both sides on the Eastern Front.

At higher echelons motor messengers or couriers were usually equipped with motorcycles. The US tended to use ¼-ton utility trucks ("jeeps") later in the war, finding them easier to train couriers to drive and more mobile in mud and snow. British dispatch riders also used motorcycles or jeeps. While slower than telephone and radio, couriers were necessary when delivering lengthy operations orders, with supporting operational and logistics documents, maps, overlays, encryption keys, and so on. The content of messages varied greatly and could cover any number of areas: confirmation of locations reached or actions/missions accomplished; relayed intelligence information, or reports of changes in the tactical situation; reports of enemy locations, weapons or activity; requests for fire support, for reinforcement, for ammunition, or for supplies or rations.

Message-carrying dogs saw only limited use, and usually early in the war. Dogs required a great deal of training and were difficult to replace when killed, wounded, or ill; they lacked the same stamina as humans under harsh climate conditions, and were very susceptible to sickness. One could not simply requisition a new dog: a dog required two handlers, one at each end of the mission, and they had to train together, which was a lengthy process. Often a dog would only respond to its handlers, not to a stranger – if a handler became a casualty then the dog was essentially useless, and in some instances had to be destroyed. The advantages were that dogs were faster than men over moderate distances, and could traverse dense vegetation, rough ground, and

A British signaler operates a portable Aldis signaling lamp. It is fitted with what appears to be a telescope sight to ensure precise aiming, which made the Morse code flashes easier to read for distant receivers. An Aldis variant model mounting a slimmer peep sight with a cruciform aperture came in a shoulder-slung steel carrying case with a large battery compartment, an integral Morse key on the inside of the open-flat case lid, and instead of this pistol grip a screw-on sectional ground-spike for fixed use.

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small water obstacles better than a man. The US Marine Corps was one of the few regular users of messenger dogs from November 1943. A war dog platoon had 18 scout dogs and handlers and 18 messenger dogs with 36 handlers. This was enough for two teams to be stationed at each of a division's nine infantry battalion headquarters, with handlers detailed to the three regimental headquarters. Mongrel dogs were considered the best suited, but German Shepherds and Dobermans were also used. Messages were carried in a first aid pouch attached to the collar; some other armies used elaborate "saddlebag" pouches. (Carrier pigeons, widely used in World War I, were still occasionally employed in World War II.)

Airdropped messages were delivered in small tubular containers with a screw-on cap and usually a weighted nose. They had a red or orange cloth streamer attached, but the Germans used one generating orange smoke. The US container was a small canvas pouch with a sand-filled compartment at the bottom and a snap-secured message pocket above it, and an 18in red web strap served as a streamer. These were dropped by observation and liaison aircraft; such aircraft may have had radios, but they could not net with ground units – and even if they could, they would not know the frequency and callsign. In a pinch, messages were dropped in ration cans, hand-grenade containers or ammunition cans, or simply stuffed in a glove or wrapped in a handkerchief with a few pistol cartridges for weight.

Written messages could also be picked up by light aircraft. A looped cord was hung between two 10–12ft poles set 15–20ft apart. A message pouch (or sock) was attached to the cord, hanging at the bottom of the loop. The poles were sited so that an aircraft could fly into the wind with a long, clear approach. The pilot flew at low level, trailing a rope with a light grappling hook through an open door or window; this snagged the looped cord, and was hand-pulled into the aircraft.

Audible signals

Other than a loud "parade-ground voice," audible means of communication were little used. Whistles were frequently carried by platoon NCOs and officers, especially early in the war, but generally these seem to have fallen by the wayside in later years; most people deemed them more appropriate on the drill field than the battlefield. Portable sirens, whistles, vehicle horns, bugles, gongs (suspended shell casings or pipes), and rifle shots were sometimes used to pass pre-arranged signals or warnings, especially of air raids and gas attacks, and rattle alarms were sometimes used to warn of the latter.

UNIT COMMUNICATIONS EQUIPMENT

UNITED STATES

The US Army pioneered the use of FM tactical radios, but relied on AM as well. The beginning of the war found the Army with only two suitable (though inadequate) AM radios at the small unit level.

The 1939 SCR-195 was one of the first AM man-packed radios capable of being operated on the move, and was used at company and battalion levels. Its frequency coverage was 53–66MHz, range was only 2 miles under good

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The US Army's SCR-284 was man-packed in three heavy loads. A critical component was the GN-58A hand-cranked power generator, here operated by a hired native during one of the Pacific or CBI campaigns; batteries were available, but were both heavy and short-lived. The operator is transmitting via Morse code; the small box atop the transceiver is a loudspeaker used for voice traffic.

conditions, and battery life was short. The SCR-194 was the artillery version, with a frequency coverage of 27–65MHz; the two sets could not net with one another, preventing cross-communications. This was a common drawback at that period, as a single radio could not accommodate the number of necessary frequencies. Although the frequency coverage of the two radios overlapped, this did not always allow for intercommunications owing to some of the overlapping frequencies being assigned to other units.

In 1940 a new radio was fielded for the horse cavalry. This was the SCR-511, commonly known as the "pogo stick radio" or "guidon radio" (see Plate C). This unusual AM radio consisted of a small box housing the transceiver, with a short metal pole protruding from the bottom and the antenna from the top. The bottom pole had nothing to do with the radio's operation; it was meant to be fitted into a cavalry guidon flag-holder attached to the saddle's stirrup, and the radioman held the antenna in the same manner as a guidon. The speaker and battery were fitted in a small chest unit, and earphones were necessary; an external power supply unit was also available for a longer-life battery. As horse cavalry was being phased out, this unusual radio was pressed into service by the infantry, with one assigned to each platoon and two to the company headquarters. The "pogo stick" was none too popular owing to the awkwardness of carrying the 20lb set; some units removed the bottom pole, especially since some men thought it was supposed to be jammed into the ground for operation. Its frequency range was limited, 2–6MHz, but it did have up to a 5-mile range, which was exceptional for the period.

One of the most successful radios of World War II saw its first combat use in Sicily in July 1943. This was the Motorola-designed SCR-300, the Army's first portable FM radio. The famous man-packed "walkie-talkie" provided relatively clear reception and was reasonably reliable.[3] It was also the first tactical radio that was "tropicalized" for use in the Pacific, where heat, humidity, fungus, and salt air destroyed radios. At 38lb it was heavy, and

3 The term "walkie-talkie" was first applied to the back-packed SCR-300, and "handie-talkie" to the hand-held SCR-536. It was only later that the term "walkie-talkie" came into general use to describe any small hand-held radio.

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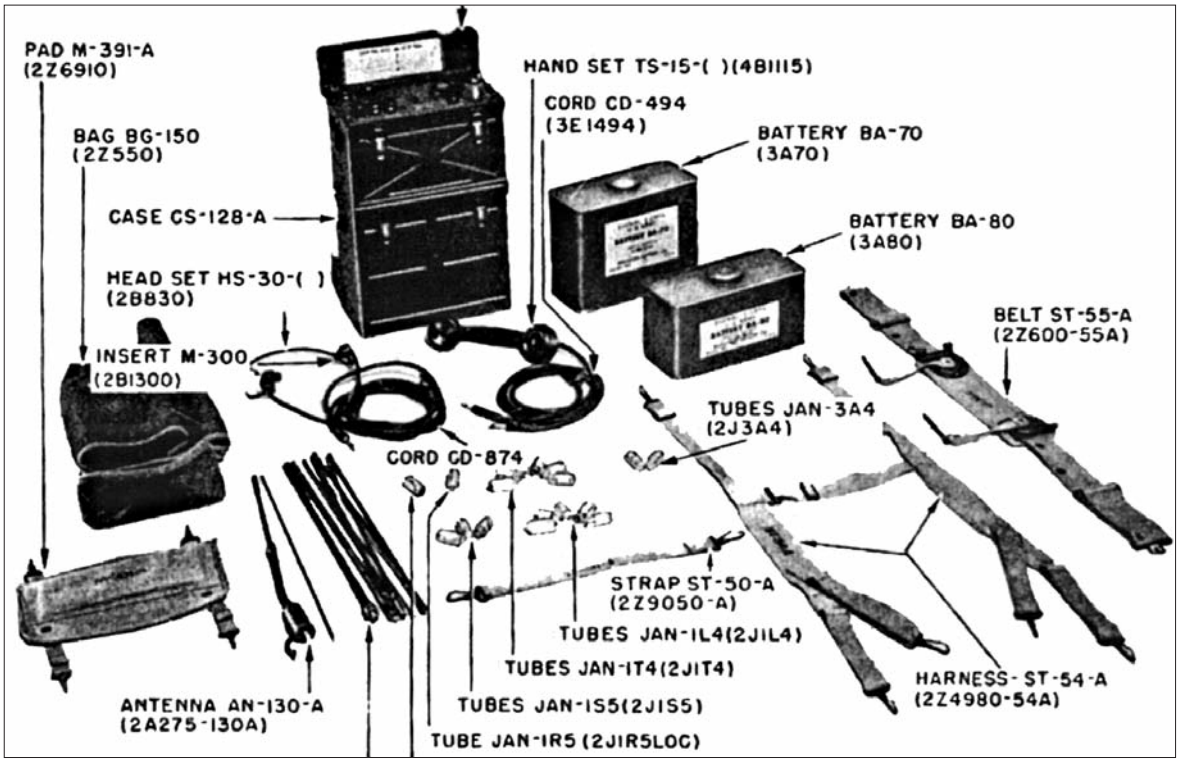

Manual illustration of the SCR-300 "walkie-talkie" with its complete array of components and accessories – see Plate B3.

it had a range of only 3 miles. The "300" was allocated on the same scale as the SCR-511 for contact between companies and battalion. A shortcoming was the inability of the infantry to talk to supporting tankers; in late 1944 a tank-mounted version of the "300," the AN/VRC-3, was provided to tank platoon leaders, covering the same 40–48MHz frequency range.

An iconic World War II radio was the SCR-536, the Motorola-designed "handie-talkie" of 1942. Weighing 6lb, it was originally developed for use by paratroopers, but saw widespread use in the infantry. It was described as a "stop-gap" radio, but it remained in use through the war. It had a frequency coverage of 3.5–6MHz, and only one pre-set channel could be used, with no alternative channel. The earphone and microphone were integral to the radio, which was turned on and off by extending or closing the 39in telescoping antenna. This was an AM radio; it could not net with an SCR-300, and

B

US COMPANY AND PLATOON RADIOS

Four of the most commonly used US radios at battalion, company and platoon levels, these SCR sets were also provided in large numbers to the Soviets and Free French.

(1) The famous SCR-536 "handie-talkie" was used for communications between platoons and company HQ. To operate it the antenna protector was removed and the telescoping antenna was extended, which turned the radio on.

(2) The awkward SCR-511 "pogo stick" radio had been used earlier for communications between platoons and company, until replaced by the SCR-536; the separate PE-157 power supply unit is shown at the operator's feet. The talk switch is in the handgrip, between the antenna and the BC-745 transceiver mounted at the center of the staff, and the operator spoke into the "trumpet" of the bulky T-39 chest unit holding the battery and microphone.

(3) The back-packed SCR-300 "walkie-talkie," employed at company and battalion levels, was one of the first effective FM tactical radios. The slim HS-30 headset – shown hooked round the antenna base – could be used while wearing a steel helmet, and throat microphones were also available.

(4) The Marine Corps used the TBY series of "ultra-portable" back-packed radios mainly at battalion level, but they were sometimes attached to companies. From mid-1944 the USMC began using the SCR-300 and SCR-536 in quantity.

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realistically the only other radio it could talk to was another SCR-536. This limitation was further aggravated by its range, of between 100ft and 1 mile; this was strictly an intra-company radio, allowing platoon leaders and the company CP to talk to one another. (The "handie-talkie" is often seen in movies with the operator requesting gunfire directly from ships or artillery units, talking to higher headquarters or to stations miles away — all absurd impossibilities.)

The SCR-284 was a heavy AM set provided in two versions: a man-packed set carried in three 55lb loads – including generator and accessories — and a vehicle-mounted model also carried in jeeps. The man-packed version, which was set up on extendable legs, could not be operated on the move. To make it more portable some units carried it assembled on a litter (stretcher), but the crew still had to halt and set up the antenna and power generator. Its frequency coverage was 3.8–5.8MHz , and it could transmit using voice or CW. The man-portable version used a battery-powered receiver while the transmitter was powered by a hand-cranked generator; the vehicle version operated entirely off the vehicle's battery system. A short pole or wire antenna could be used. Employed for contact between battalion and regiment, the SCR-284 saw its first combat use in November 1942 in North Africa. The SCR-284 began to be replaced in 1945 by the SCR-694, but few units received this. It had capabilities similar to its predecessor but was much more reliable. Its frequency range was 3.8–6.5MHz; the set weighed 191lb, and had voice and Morse ranges of about 15 and 30 miles respectively – the same as the SCR-284.

Okinawa, 1945: a US Marine Corps radioman transmits on an SCR-300 at a battalion command post set up in front of a traditional hillside tomb. Note, on the left-hand side of the two sets, the canvas accessory bag for antenna sections. Field telephone wires can be seen passing between the jars in the left foreground. (Photo by J.R. Eyerman, *Life* Magazine/*Time Life* Pictures/Getty Images)

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US signal equipment designations

US radio equipment was designated "SC" (Set, Complete) from 1909. There were only three designators in this system: SCM – Set, Complete, Meteorological; SCR – Set, Complete, Radio; and SCS – Set, Complete, System. An SCS designator identified interrelated SCR radio sets that were part of an interconnected signal system.

By about 1941 it was generally accepted that SCR meant "Signal Corps Radio," but there was no official date for the change in meaning. As new electronic items were developed equipment other than radios also received the SCR designation, such as radar and mine-detectors. Technically these items were radio transmitters and receivers, but the system of designation became confusing; still, it did preserve the secrecy of the development of radar and other special equipment, since identity could not be determined from the SCR designator. There was also a bewildering array of two-letter designators for components and accessories, e.g., AT – antennas, BA – batteries, BC – basic components (such as a transceiver – combination transmitter and receiver), RD – switchboards, EE – telephones, GN – generators, HS – headsets, LS – loudspeakers, and dozens more. "BC" sometimes leads to confusion, as the BC-1000 was the transceiver for the SCR-300 radio and the BC-611 was the core component of the SCR-536. The "BC" designations are sometimes used to identify these radios rather than "SCR." Improved versions of a particular item of equipment were identified by an appended letter, e.g. the SCR-300-A.

On February 16, 1943 a new designation system was introduced. This Joint Electronics Type Designation System is commonly known as the "Army-Navy System" or "AN System" (this does not mean that both services use the same designated equipment item). Under this system, still in use today, equipment designations consist of "AN/" followed by a three-letter code identifying the installation type, equipment type, and purpose, and then by a series number. Existing equipment was not redesignated, new items under development retained the old designation, and it was late in the war before equipment designated by the AN System was introduced. There are countless combinations of the three code letters; those most commonly used for ground radios included:

GRC – Radios operated in a vehicle or that could be removed and back-packed.

PRC – Man-portable hand-held or back-pack radios.

TRC – Vehicle/pack mule-transportable radios operated as a ground station.

VRC – Vehicle-mounted radios including those in tanks.

The SCR-609, an FM man-portable but not man-packed radio, was used by artillery spotters. With a frequency range of 27–38.9Mhz, it replaced the pack-carried SCR-194 in 1942.

The standard field telephone was the EE-8 ("double easy-eight"), a rugged and reliable 9.5lb set that remained in use from before World War II into the 1980s; it had an 11–17 mile range on standard field wire, and was powered by two D-cell flashlight batteries, which the Army called the BA-30. The 3lb TS-10 sound-powered telephone was simply a handset with clips on a cable to attach to field wire. Switchboard equipment included the six-line, 48lb BD-71 at battalion level, and the 12-line, 72lb BD-72 at regimental level; there was also a six-line, 5lb SB-18/GT emergency switchboard, issued in 1945 for use in the front line where mobility was essential. The TG-5 telegraph was a portable set that could be connected to field telephone lines to provide longer-distance transmission.

The US Marine Corps were initially somewhat untrusting of radio communications below battalion level, and few sets were issued. This mistrust was understandable given the limitations of period radios, and the facts that hilly jungle terrain reduced their range by as much as 30–60 percent, hot and humid conditions shortened battery life, corrosion and moisture altered

(continued on page 28)

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Italy: a US 88th Infantry Division soldier speaks on an SCR-536 "handie-talkie" radio, his left hand depressing the talk switch – see Plate B1. The set was turned on by extending the telescoping antenna, and turned off by closing it. The finger-like projection is the waterproof cap that was screwed over the closed antenna when not in use, and to a fitting atop the radio when the antenna was extended. (Photo by Margaret Bourke-White/*Time Life* Pictures/ Getty Images)

C ALLIED & GERMAN TACTICAL RADIOS

(1) The back-packed British WS No.18, linking companies to battalion, reached the troops only in 1940/41, being trialed that winter at the Lochailort training center for the newly raised Commandos. It is shown here with the top and bottom steel flaps and the fold-out canvas weather cover open; dimensions were 10in × 17in × 8in, including the upper receiver and lower transmitter units and the case for the dry battery under the latter. For mobile use 12 × 1ft-long antenna sections were carried clipped to the sides for assembly as needed, and a ground aerial was carried in the separate satchel, along with spare valves and a Morse key. The No.4 hand microphone is illustrated (hand mics incorporated a talk switch), and two headsets for the operator and his officer – the No.2 had both wire and web yokes, so that it could be worn under a helmet when necessary.

(2) The voice-only WS No.38 of 1943 is shown here lying on its front, i.e. with the face that was against the operator's body uppermost, showing the web cradle with D-ring and narrow waist strap. The No.38 matched the 1–5 mile range of the No.18, and in the last year of the war it was available – though not universally – at the platoon-to-company level. At 27lb it was 7lb lighter than the No.18, and its profile allowed the operator to take cover much more easily. The No.2 junction box, carried in the separate satchel, connected the set to the battery**,** the headset and the No.2 throat microphones.

(2a) WS No.38 operator, spring 1945; by this date some British line infantry had received Denison camouflage smocks (though the "windproof" hooded type was much more common). Note the throat microphones, a welcome hands-free innovation. The "satchel, signal" – here shown buckled on the back to the 37 Pattern web suspenders, but alternatively carried slung at one hip – held the battery and the junction box; the battery and microphone leads are shown passing up under the ghost left arm, while the headset Y-lead passes down behind the neck. Operators wore only one "pouch, basic" for ammunition (here with a Mk III helmet hooked to it), and by D-Day many had been issued Sten guns instead of rifles. The radio's web cradle hooked to the other side of the equipment, steadied by the waist strap attached to it at the bottom rear.

(3) The Soviet 6-PK (aka RKRM) was one of the Red Army's several portable radios; it was of mediocre construction, and the case was made of canvas-covered wood. Weighing 48lb and carried by two men, it linked battalions to their regiment, and as well as use with a rod aerial it could also be connected to telephone wires.

(4) The German *Tornister Funkgerät d2* or "Dora 2" was employed both for communications between battalions and regiment, and for linking rifle and support companies with battalion. It could be used on the move; the carrier back-packed the radio (left) and the operator walked behind him packing the battery and accessory case (right). Here, the battery, headset and hand microphone leads are artificially shortened to fit the illustration. (**NB: Images not to scale.**)

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Normandy, July 30, 1944: during an attack south from Caumont, a sergeant-major of the 2nd Bn Glasgow Highlanders from 15th (Scottish) Division follows his operator, using the second set of earphones from a WS No.18 radio – see Plate C1. Radio operators and those around them were prime sniper targets; the bulky No.18 set with its thick sectional rod aerial was highly visible, and made it hard for the operator to take cover. (Imperial War Museum, London; B8203)

frequencies, and that the heat burned out vacuum tubes faster. Instead, the Marines relied heavily on messengers and telephones. The USMC used the sound-powered Type MCT-1 alert telephone and later the Army EE-8. Elaborate wire nets were established and linked though BD-71 and -72 switchboards at battalion and higher levels.

The Marines initially used Navy-designed radios, but by 1944 more ruggedly built Army models were being employed. The Navy TBY-1 and -2 "ultra-portable" radios, a 37lb back-packed model capable of voice and Morse code on line-of-sight, were used at company level; six TBYs were also allocated at battalion level and a few at regimental level to allow short-range voice communications with subordinate units. Other battalion- and regimental-level radios were the TBX-1 to -6 series; these were man-portable sets, but could not be operated on the march. It required three men to man-pack the 29lb transmitter-receiver, 31lb accessory box with receiver batteries, 22lb hand-cranked generator for transmitter power, and wire antenna. While capable of voice communications they usually used only Morse code, and required at least 15 minutes to set up, transmit a message, and break down. A major complaint about the TBX was that it was inadequately waterproofed. It was recommended in late 1943 that it be replaced with the equivalent Army radio, the SCR-284, but the TBX remained in use into late 1944.

By late 1943 a radio was provided to Marine platoon leaders with a couple in the company headquarters; this was the MU, a lightweight

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battery-operated set carried in a canvas case by a shoulder strap. Its frequency range did not allow it to talk to TBYs at company level; it also proved too fragile, and its battery life too short. The Army SCR-300 and SCR-536 came into widespread Marine use at company and platoon levels in mid-1944.

BRITAIN & COMMONWEALTH

British-designed equipment was used by other Empire/Commonwealth armies, often locally produced and sometimes with modifications. US radios at the tactical level often had different frequency ranges allotted for different branches, such as infantry, artillery, and armor; the British made do with common frequencies, but seldom used frequencies above 20MHz. They also made very little use of FM, simply not accepting its superiority in certain applications.

At the beginning of the war the British infantry believed that at platoon-company level runners, face-to-face meetings between subunit commanders, and a loud voice reinforced by whistle blasts would suffice, and that radios were not needed (a belief reinforced by the reduction of rifle companies from four to three platoons). The back-packed wireless set (WS) No.18, developed by Pye, was introduced late in 1940 to link infantry company and battalion headquarters (see Plate C1). It weighed 34lbs with its battery and accessories, was too bulky to allow its operator to take cover easily, and like all wartime sets was fragile and unreliable by modern standards. It was an AM set capable of voice communication up to 5 miles and CW up to 9 miles, with up to 18 channels over a frequency range of 6–9MC; Mk II and III versions were also fielded, and by 1943 its total war production had reached 76,000 sets. (The No.28 was an alternative set on 6–9MHz frequencies, with a 3–5 mile range.)

The "18 set" remained in use throughout the war, alongside its later developments identified by higher "-8" suffixes. The WS No.48 was an American-made variant of the No.18 that was not used by the British. The No.58 was a Canadian development with no Morse facility, used as an inter-battalion ground set. The British No.68P, R and T sets were externally almost indistinguishable from the No.18 and had a similar range of 5–10 miles, but differed in minor technical details; the No.68T was tropicalized, and remained in use well after 1945. The No.68 was originally intended for use at battalion-brigade (i.e. in US terms, regiment) level by Commando and Airborne troops.

A more reliable and lighter set was desired, especially for such Combined Operations missions, and the breakthrough came late in 1942. The WS No.46 saw limited issue at company-battalion level for such special operations (it was supposed to be handed in again after each mission, but – predictably – this was wishful thinking). The small transceiver unit was carried in a web cradle hooked to the front of the 37 Pattern web equipment harness at one side, with an attached pouch

The advance to the Rhine, February 10, 1945: a British infantry radio operator in his foxhole, equipped with a WS No.38 complete with 4ft antenna and throat microphones – see Plates C2 & C2a. (IWM B144810)

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ABOVE
France, last week of May 1940, shortly before 51st (Highland) Division was sacrificed at Calais to allow the BEF's evacuation from Dunkirk. A long-service regular corporal – apparently from either 1st or 4th Bn, Black Watch – uses the voice facility of a field telephone; the combination of voice handset and wooden case suggests that it is a Type F Mk II, not the Morse-only Fullerphone. Note how it is linked to the long horizontal wire visible against the dark hedgerow above the soldiers' heads. (IWM F4616)

OPPOSITE PAGE
A dramatically posed photo of Soviet signalmen carrying a 6-PK radio, one of many types of Russian and foreign man-portable sets used at battalion level. (Stavka/Nik Cornish A39)

for a nine-section rod aerial; a separate web satchel similar to the 37 Pattern "small pack" was carried on the back, accommodating the battery, a junction box linking the set to the battery, earphones and microphone, and also a spare battery. The whole assembly weighed between 24lb and 33lb depending upon the accessories carried. The frequency range was 3.4–9.1MC; three alternative channels were available for voice or Morse code, with usual voice ranges of 2–4 miles but at least 10 miles using CW. It was crystal-controlled for reliable tuning, was waterproofed, and some ground/air use was also possible. A convenient innovation was a set of throat microphones.

The externally similar man-pack WS No.38 reached the infantry in 1943; the most common version was the Mk II, weighing 27.5lb complete with battery and accessories. It too was carried on the front of the body in a web cradle; the Mk I had its "battle battery" in the case, but the Mk II and II* carried this in the separate web satchel, again with the aerial sections in a tubular web case. It transmitted on 6.4–9MC, with a voice-only range of about 1,000 yards using a 4ft rod aerial, and 2 miles with a 12ft aerial (it could not be operated on the move with the latter). Total wartime production reached 187,000 sets, far outstripping all other types; the No.38 Mk II both supplemented the No.18 sets at company-battalion level and for other subunits, and late in the war was issued to rifle platoons (see below, "Unit Communications Systems"). Often referred to as a "walkie-talkie," in Northwest Europe in 1944–45 it was used alongside the No.18 and No.68 in the chain of communication from platoon, through company and battalion, to brigade.

A useful capability of the No.38 was described by LtCol Terence Skelly, in summer 1944 the signal officer of No.3 Commando in Normandy, where

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field telephone lines were constantly being cut by enemy fire or friendly tracked vehices:

> We had a drill whereby as soon as a line went "dis" we disconnected it from its telephone and put the ends of the line at each end into the aerial sockets of 38 sets tuned to the same frequency. Although out of range of the normal 38 set, this "wired wireless" used to work, using the broken ends of the line as a ground aerial and jumping the break.

The frontline field telephone was the Type D Mk V in a metal case, which incorporated a Morse key. At brigade level and above the Type F Mk II in a wooden case was used; this lacked a Morse key. Both six- and ten-line "universal call" switchboards were available.

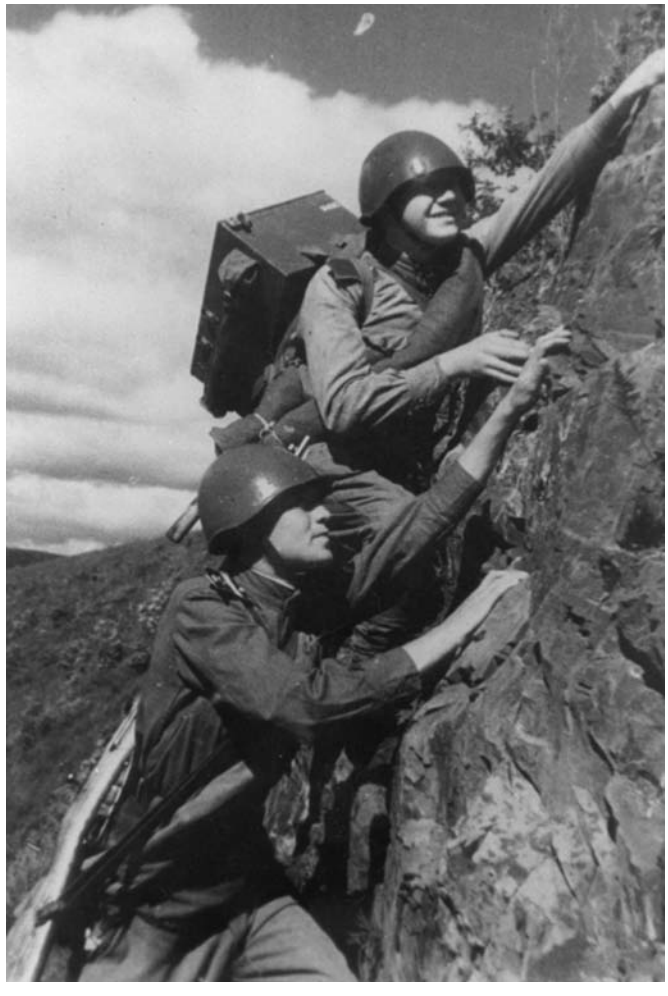
The Mk IV and V Fullerphones were also widely used. This system was developed in World War I when the Germans were found to be monitoring British telephone and telegraph transmissions in frontline sectors. The British were using ground return systems, and the Germans developed devices with which to listen in. The first Fullerphones were modified field telephones, and were required to be used to replace these within 3 miles of the front line. Improved Fullerphones were fielded, proving to be very difficult to intercept – the interceptor had to be within 180ft. The Fullerphone used telephone wire, and could be linked up to very poor quality existing lines without difficulty. Its appearance was similar to a field telephone, mounted in a wooden case with connections for a headset, handset, Morse key, and buzzer. Voice transmission was not possible.

British & Commonwealth wireless set designations

British "wireless sets" were designated by a numbering system implemented in 1933, e.g. WS No.38. Modifications to the basic set were designated by a mark number, e.g. WS No.38 Mk II, which might be shown on set identity plates as "Mk II" or "Mk 2". Minor modifications were identified by a "star", e.g. WS No.38 Mk II*. For short, the Tommy might simply call his radio a "38 set."

Commonwealth radios such as Australian-made sets might be designated e.g. WS No.11 (Aust).

The WS No.31 was a British-made US SCR-300, but was little used.



SOVIET UNION

Most pre-war Soviet signal equipment was copied from European or American designs dating from the 1930s. Attempts were made to standardize designs, improve quality, and increase production, but these efforts largely failed. Some equipment was ruggedly constructed but poorly finished, and little consideration was given to making radios lightweight and compact. Much of what radio equipment there was at the time of the German invasion in 1941 was lost in the months following, and domestic production could not replace these losses, much less supply the hugely expanding army. Radio equipment below regimental level was unheard of, and few telephones were available. Most radio production went to armored fighting vehicles and aircraft, and what ground radios were available were given to the

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Soviet signalmen operate what appears to be a 6-PK – see Plate C3. For propaganda reasons, few photos exist showing Soviet troops using examples of the large amounts of Lend-Lease communications equipment supplied by the USA. (Stavka/Nik Cornish A40)

artillery. Given the lack of standardization, any available type was issued to a unit so long as they could net.

If it had not been for US, British, and Canadian Lend-Lease the Red Army's tactical communications would have been significantly worse; it is estimated that by 1945 Lend-Lease was the source of 88 percent of their communications equipment. This included 380,000 field telephones and 245,000 radios supplied by the US, including large numbers of SCR-300, 511, 536, 584, and many other radios, along with EE-8 telephones and a million miles of telephone wire (much Soviet-made wire was defective). However, given the enormous size of the Red Army the US tactical radios were still scarce, and usually allocated only to Guards and other special units. Radios were still hardly seen below regimental level; the Soviets much preferred telephones, for their reliability and because they were more difficult to intercept. The Soviet-built radios described below were just three out of at least a dozen models that might be found at battalion-regiment level. Before the early 1950s radio designations were not standardized, but were assigned by their design bureau.

The 4-R (aka RBS-40) was an AM radio operating on 33.25–40.5MC; it could also be connected to wire and used as a telephone. The 40lb set was carried by a shoulder strap hanging on the side, and could be operated on the move with a rod-type antenna. Range was claimed to be up to 7 miles, but this is doubtful. Unlike many Soviet radios it was ruggedly constructed, with quality parts. Less well built was the 6-PK (aka RKRM), a back-pack set in a flimsy canvas-covered wooden case. This weighed 48lb and was carried by two men; it could not be operated on the move. It was AM and could transmit by both voice and CW; oddly, its transmitter frequency range was 3.75–5.25MC and the receiver's was 3.75–5.5MC. The A-7-A was a rarity in that it was a 50lb FM set that could be carried by one man and placed in operation in five minutes, but not operated on the move. It was found at regimental level and had a range of up to 6 miles, with a frequency coverage of 22–27MC.

The Red Army used about a dozen different Soviet field telephones as well as American, French, German, Japanese, Norwegian, and Swedish sets purchased prior to the war. It was forbidden to use ground-return telephone systems, since they could be monitored, though an exception was the lightweight TAT-F used by paratroopers. Many of these sets – all of which had wooden cases – were intended for division and higher echelons and rear area use. Two of the most common frontline telephones used at company, battalion and regimental levels were the UNA-F-28 and UNA-F-31,

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A German radioman operates a *Tornister Funkgerät b1;* note his mosquito head-net – a necessity on many parts of the Eastern Front in summertime. As usual, the transceiver is set atop the battery/accessory case for operation; note the low rod antenna rising from the top of the transceiver.

along with American EE-8s, which could be used in the same wire system; in 1943 production of the widely used TAI-43 began. At battalion level the two most common switchboards were the FOF-28 and the similar but improved FOF-33, both being very small six-line models; at regimental level 12-line RE-12 switchboards were used.

GERMANY

German radios were well constructed of quality materials. The sturdy cases were made of a magnesium-aluminum alloy, and many components were standardized and interchangeable between sets. They were also of modular

German radio designations and frequency ranges

German man-portable radios were designated as *Tornister Funkgerät (Torn.Fu.)* – "back-pack radio equipment" – followed by a lower-case letter and a number if a modification, e.g., Torn.Fu.b1. When spoken the letter model designation was referred to by its phonetic alphabet word. *Feld Funkgerät (Feld.Fu.)* – "field radio equipment" – identified portable and stationary radios, while radios that were mounted in armored vehicles were simply designated *Funkgerät (Fu.)*.

Funkvorschriften (Radio Regulations) specified what branches used what frequency ranges, and there were frequent changes in the allocation. Those for man-portable sets included:

Model	Frequency range (KC)			
	Transmitter	Receiver	Power (watts)	Use
Torn.Fu.b1	3000–5000	3000–6600	0.6	all branches except infantry
Torn.Fu.c	1500–2300	1500–2600	0.6	artillery
Torn.Fu.f	4500–6670	3000–6600	0.6	artillery
Torn.Fu.h	2300–5500	2300–5500	1.0	
Torn.Fu.k	4500–6067	3000–6067	1.5	

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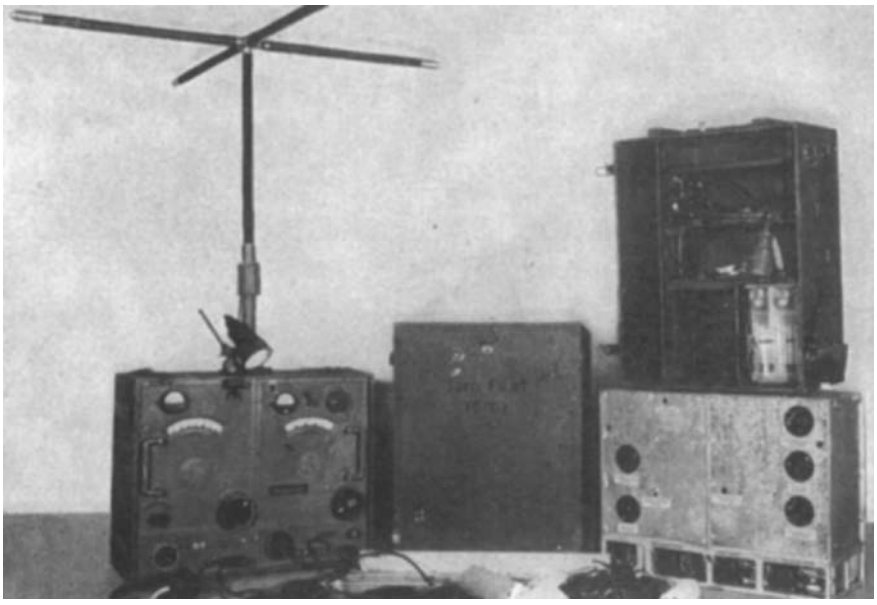

Another view of the Torn.Fu.b1, with all equipment. It required three men to carry it, and could not be operated on the move. The low rod antenna is fitted, here with three sections; the high rod antenna could be raised as high as eight sections.

construction, which made it easy to access and replace components. Since virtually all of the world's crystals came from Brazil, Germany developed very effective temperature-compensated variable oscillators to replace them; this was no crude *ersatz* substitute for frequency crystals, but provided exceptional frequency tuning and stability.

Few of the back-pack radios could be operated on the move; they were carried by two or three men and had to be set up before operating. The most common sets were the Torn.Fu.b1 ("Bertha"), Torn.Fu.c ("Cäsar"), Torn.Fu.f

D PYROTECHNIC PROJECTORS AND PISTOLS

(1) The US used two hand-held projectors at platoon/company level for launching colored signal flares and smoke rounds for marking locations. This 40mm M4 (shown disassembled) measured just under 12in long, and took a variety of parachute flares and star-cluster signal rounds. These were pushed down the muzzle until gripped by the sprung retainers round the firing pin; the projector was fired by striking the base on a hard surface. **(1a)** M17 white star parachute flare; projected fins first, such rounds reversed themselves after 100ft of flight.

(2) The 37mm US M9 projector was breech-loaded with single- or double-star aircraft signal rounds; it could be fired by slapping the plunger with the palm of the hand. **(2a)** AN-M42 green/yellow star aircraft signal round.

(3) A number of long- and short-barreled British flare pistols were essentially unchanged since World War I; this is the 1in-caliber No.2 Mk V. There was also a 1.5in-cal No.3 Mk I. A brown leather holster based on the old Sam Browne type was available, but they were as often carried simply tucked into the belt or behind the ammo pouches, secured by a neck lanyard. **(3a)** "cartridge, signal, red, 1 inch, Mk XIV."

(4) The Australian 1in No.1 Mk III had a brass frame and barrel; the otherwise similar British Mk III pistol used zinc.

(5) Soviet 27mm M1943 flare pistol

(6) The German short-barrel 2.6cm flare pistol (*Leuchtpistole mit kurzem Lauf*), made by Walther and introduced in 1934, was used throughout the war. **(6a)** Short cartridge, blue star; **(6b)** long cartridge, blue star.

(7) German Obergefreiter loading the later 2.6cm LP42 pistol, made from cheaper steel stampings. A flare-pistol holster, expensively produced in black leather, had on the rear both belt loops and D-rings for a shoulder strap, and front loops for the cleaning rod. The slung flare cartridge pouch – initially in leather, later in drab green canvas – held 18 rounds, quickly identifiable end-on by their color-coded bases. **(7a)** The soldier has a *Feldtaschenlampe "*field pocket torch" buttoned to his pocket; used with a clear lens as a regular flashlight, it had sliding buttons for red, green or blue filters. **(7b)** A multi-star round is being loaded, with a preliminary yellow star followed by three red and three green, indicated externally by three dots of each colour.

(8) Japanese Army 35mm Nambu Taisho Type 10 (1921) flare pistol.

(9) 27mm double-barrel Type 90 (1930), as used by Japanese Special Naval Landing Forces. The SNLF also had a three-barrel version, with the third centered above the lower two.

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The most common German radio used at infantry battalion and regimental levels, and attached to companies, was the Torn.Fu.d2 "Dora 2," here carried by Waffen-SS troops – see Plate C4. The man to the right is operating the Morse code key and carrying the battery/accessory case. The Torn.Fu. "Cäsar" to "Konrad" models were all externally similar, the difference being in their frequency coverage.

("Friedrich"), Torn.Fu.h ("Heinrich"), and Torn.Fu.k ("Konrad"). This series of radios dated from 1935–37 and appeared outwardly similar, the main differences being frequency coverage. These radios were used by regimental signals platoons and battalion signals sections. They were AM sets weighing about 20kg (44lb), capable of voice transmission to 6 miles and CW to 12 miles. They came with a 100m cable with a handset, thus allowing an observer/operator to be in a forward position while the radio and antenna remained under concealment to the rear.

This Torn.Fu.b1 (or variant) is being operated from a slit trench in the voice mode; the *Funker* is speaking on a microphone.

A lighter radio used by the infantry at regimental and battalion levels was the 17kg (37.5lb) Torn.Fu.d ("Dora") or the much improved d2 model, operating on 33.8–38MHz with a voice range of about 6.5km and 15km using Morse (4–9 miles). This could be operated on the move; one man carried the transceiver and the operator walking behind him carried the heavy battery/accessory pack, either speaking or operating the Morse key. The "Dora" required 5–8 minutes to place in operation. The Torn.Fu.g ("Gustav") was an excellent radio used by Panzergrenadiers to maintain contact with their halftracks. Its frequency coverage was 2.5–3.5MHz with a 1.5 watt power output. It used a whip antenna, could be carried by one man (18.3kg/40lb), and operated on the move.

The standard field telephone was the *Feldfernsprecher 33*, a good piece of equipment but heavy at 12lb. The small switchboard for ten lines (*kleiner Klappenschrank zu 10 Leitungen*) and the field switchboard for 20 lines (*Feldklappenschrank zu 20 Leitungen*) were used at battalion and regimental levels respectively.

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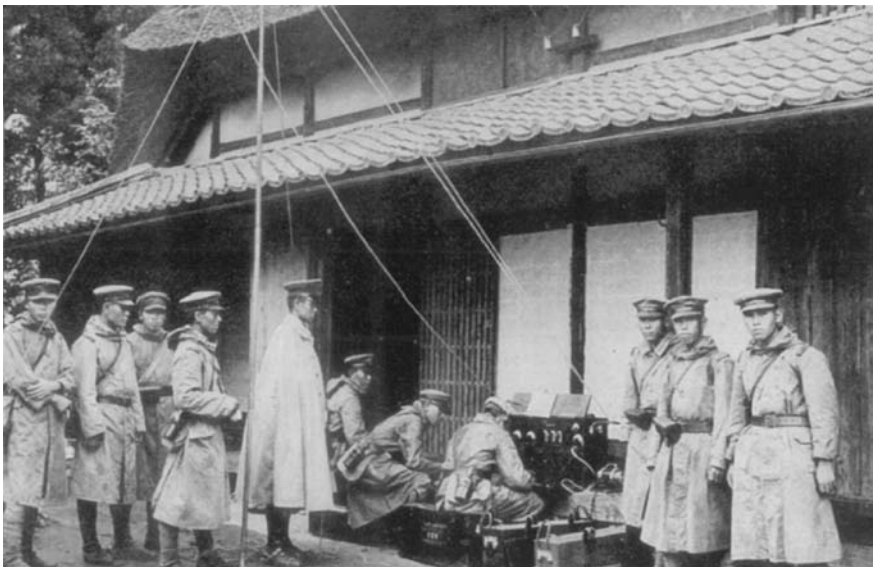

Japanese troops on a pre-war exercise observe a base radio station in operation. The wooden boxes in front of the radio set are the packing crates in which the radio and its accessories are carried by packhorse – the main means of equipment transportation in most Japanese units.

A great deal of German military radio equipment was ordered destroyed after the war to prevent its use by any emerging Nazi resistance.

JAPAN

Radios were secondary to wire in the Japanese communications system; radios were used while troops were advancing, but as soon as a wire system was established the radios went on standby. Messengers were also an important means of communication. On Pacific islands the defenders found it was almost impossible to maintain wire communications owing to the massive Allied artillery, mortar, naval gunfire, and aerial bombardment. Radios did not last long either; they were often located by US forces through direction-finding or neutralized by jamming, or simply failed through their inability to withstand the rigors of the tropical battlefield – their waterproofing and fungus-proofing was very poor.

The Japanese were often forced to conduct counterattack and withdrawal planning during the day, and then dispatch messengers after dark to deliver orders to units for execution before dawn. It was an extremely slow process and unresponsive to immediate needs; often, by the time the units received their orders and were prepared to execute them the situation had changed.

At the outbreak of World War II Japanese radios were rather crude and obsolete, with the latest designs dating from the mid-1930s. Only AM sets were available; they were simple to service and maintain, but their frequency stability proved to be poor and they had overly complicated controls. However, Japanese radio operators underwent lengthy instruction, were well trained, and could often get a lot out of their crude equipment. Consideration had been given to making radio designs as portable as possible. Small man-packed radios were carried on the chest with the battery pack on the back; other sets were portable by three or four men, but could not be operated on the move.

The most common tactical sets were the Type 94 (1934) series, and at division and regimental levels the Type 94 Model 3 was used. Carrying cases were provided for the transmitter, receiver, remote unit, and hand-cranked power generator. The transmitter covered 0.4–5.7MC and the

Japanese radio designations

Japanese radio equipment designations can be confusing, largely due to the terms employed since the war by collectors, whose translations are not always correct and do not follow a standard. The terms "Type" and "Model" are used interchangeably, as are "Mark" and "Number" (Mk and No.) for modifications. Sometimes Type numbers are simply followed by a hyphenated number to designate a modification. The term "type" is used to translate the Japanese ideograph *shiki*. Some reference books and contemporary intelligence documents translate this as "model," but "type" is correct; the Japanese ideograph for "model" is *kata*. The type is a two-digit number indicating the Japanese year when the equipment was adopted. Much of the radio equipment was adopted in the Western calendar year of 1934, which was the Japanese year 2594. Subtracting 660 from the Japanese year gives the Western year (e.g., 2596–660 = 1936).

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An assistant transcribes the message received by a Japanese field telephone operator, for delivery to the unit commander. The telephone is a Type 93 (1932); originally of relatively good construction, its quality deteriorated as the war went on.

receiver 0.3–6.0MC. The lighter Type 94 Model 5 and 6 were used at battalion and company levels. The Model 5 had 1–2 miles voice range and 5 miles with CW; the Model 6 was a "walkie-talkie" type radio with a 1–2 mile range. Besides being man-packed by several men, these radios could be transported by packhorse.

The Japanese preferred and relied heavily on field telephones, which were of the ground return type. The standard telephone was the Type 92 (1932) fitted with separate mouth and earpieces. Field switchboards were provided at battalion and higher echelons to establish party line systems.

COMMUNICATIONS PROCEDURES

PHONETIC ALPHABETS

All countries had standardized procedures for radio, telephone, and other communications means, of which perhaps the most basic was the phonetic alphabet. The purpose of phonetic alphabets is to ensure that letters are clearly understood when spoken during voice transmission. An International Code of Signals was adopted in 1897 as a means of communicating by flag, semaphore, and lamp; problems during World War I led to refinements at the 1927 International Radiotelegraph Conference in Washington, and the new version was adopted in London in December 1928. Originally, only certain letters were identified by words to differentiate them from similar-sounding ones – for example, B, C, D, E, G, P, and Z – and easily understood letters were not assigned words, which were only assigned to all letters in 1938.

In World War II the US Army used a different alphabet from that used in World War I, with many letters assigned a different word. The Flag and International Code Alphabet used during World War II was slightly modified in early 1941 by the replacement of certain words. In typed message transcription the phonetic words were usually shown in upper case, e.g., SUGAR SUGAR for "SS." The following system was used until March 1, 1956, when the NATO Phonetic Alphabet was adopted.

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US International Code Alphabet, 1941

A ABLE	J JIG	S SUGAR
B BAKER	K KING	T TARE
C CHARLIE	L LOVE	U UNCLE
D DOG	M MIKE	V VICTOR
E EASY	N NAN	W WILLIAM
F FOX	O OBOE	X X-RAY
G GEORGE	P PETER	Y YOKE
H HOW	Q QUEEN	Z ZEBRA
I ITEM	R ROGER	

British & Commonwealth code alphabet prior to 1943

Before the US entry into the war imposed the need for the Western Allies to standardize in 1943, the British and Commonwealth forces used a different phonetic alphabet. When spelling out individual letters in voice transmissions they would normally be spoken as, e.g., "G for George."

A ACK	J JOHNNY	S SUGAR
B BEER	K KING	T TOE
C CHARLIE	L LONDON	U UNCLE
D DON	M MONKEY	V VIC
E EDWARD	N NUTS	W WILLIAM
F FREDDIE	O ORANGE	X X-RAY
G GEORGE	P PIP	Y YOKER
H HARRY	Q QUEEN	Z ZEBRA
I INK	R ROBERT	

Both the US and British forces had a standard method to ensure the clarity of spoken numbers. Each number was spoken individually – e.g. "five-six," not "fifty-six." "Two-hundred" could be spoken, but "two-one-zero" was necessary for "210."

0 zero (never "oh" or "nought")	5 fi-ver
1 wun	6 six
2 too	7 seven
3 thuh-ree	8 ate
4 fo-wer	9 niner

Japanese radio operators learn to type the received code messages on typewriters using the *kana* alphabet/syllabary system; note the paper rolls, eliminating the need to continuously insert single sheets of paper.

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Standard "**procedure phrases**" (aka pro-words) were used by the US and British to ensure clarity when transmitting verbal messages on radio and telephones. Messages would begin with the caller identifying the callsign of the station to which he was transmitting, followed by his own: "ABLE BAKER TWO, (this is) CHARLIE BAKER THREE." Common procedure words and phrases included the following:

Pro-word or phrase	Meaning
Acknowledge	Let me known you have received and understand the message.
Roger*	I have received your transmission.
Wilco	Last message received, understood, and I will comply.
Wait	I must pause a few seconds.
Wait Out	I must pause longer than a few seconds.
Say again**	Repeat what you just said.
I say again	I am repeating what you requested.
How do you hear me?	Respond with weak, clear, poor, etc or strength 1 to 10 (greatest).
Speak slower	To ensure clarity.
I spell	Followed by the phonetic word of each letter in the word(s) spelled.
Over	My transmission is ended and you may respond.
Out***	This conversation is ended and no response is expected.
Notes:	
* "Roger" was used simply because it was the phonetic word for "R" – "Received."	
** "Repeat" was never used except when requesting the repeat of a fire mission or air strike.	
*** "The phrase "Over and out" was incorrect; only "Out" was necessary.	

German code alphabet

The German *Phonetische Alphabet* or *Buchstabiertafeln* used both male and female first names (the parenthesized words below are early alternatives). Umlauts (ä, ö, ü) are long letters; when written in English they may be expressed as "ae," "oe," and "ue." The German character "ß" (*eszett*–pronounced "ess-zett") signifies a double "s" and is written in English as "ss"; phonetically it was transmitted as "*Siegfried-Siegfried*." The Germans designated some units and formations with Roman numbers: battalions organic to regiments, brigades organic to divisions, army corps, and some other commands. When transmitting Roman numbers by radio and telephone the numbers were spoken as Arabic numbers, but preceded by the word "*römisch*" (Roman): for example, "*römisch ein zwei Armeekorps*" ("Roman One-Two Army Corps," for Twelve Army Corps). The Germans conveniently affixed a plate to field telephones listing the phonetic alphabet. This system, with a few minor changes, is still used by German civilian organizations:

A Anton	I Ida	R Richard
Ä Ärger	J Julius	S Siegfried*
B Berta (Bruno)	K Konrad (Kurfurst)	T Theodor (Toni)
C Cäsar	L Ludwig	U Ulrich
Ch Charlotte	M Martha	Ü Übel
D Dora	N Nordpol	V Viktor
E Emil	O Otto	W Wilhelm
F Friedrich (Fritz**)	Ö Ödipus	X Xanthippe
G Gustav	P Paula	Y Ypsilon (Ypern)
H Heinrich	Q Quelle	Z Zeppelin

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Notes:
* "Schule" was used as a phonetic word for "sch."
** "Fritz" is believed to have been dropped owing to it being a common British and Russian nickname for the Germans.

Russian code alphabet

The Russian phonetic alphabet used male and female first names to identify the Cyrillic alphabet characters. Here the alphabet is transliterated into English letters (as far as is practically possible without diacritic marks, some of which are indicated here by superscript numbers), but in the alphabetical order of the original Cyrillic characters:

A	Anna	K	Konstantin	F	Fedor
B	Boris	L	Leonid	Kh	Chariton
V	Vassili	M	Michail	Ts	Zaplya
G	Grigori	N	Nikolai	Ch	Tschelovek
D	Dimitri	O	Olga	Sh	Schura
E	Yelena	P	Pavel	Shch	Stschuka
J	Shenya	R	Roman	I^3	Ery
Z	Sinaida	S	Semyon	E	Yeri
I^1	Ivan	T	Tatyana	Yu	Yuri
I^2	Ivankratki	U	Ulyana	Ya	Yakov

Japanese *katakana* syllabary characters

The Japanese writing system, *kanji*, is based on the Chinese system and contains up to 50,000 distinct ideograph characters and 530,000 compound words. Of these, the average Japanese knew approximately 5,000 characters. Obviously this system was impossibly burdensome for rapid communications, and a Morse code-like system was impossible. The Japanese therefore used a much simplified system called *katakana* or *kana*. In official documents and newspapers both *katakana* and *kanji* were used as appropriate. In *kana* each character represents a sound similar to English letters, and it consists of 50 characters noticeably different in style from *kanji*. *Kana* was used in documents, telegrams, notices, and for transliterating foreign words, especially placenames; aircraft markings and ships' names were rendered in *kana,* and it also allowed the use of a Morse-type code system.

ア a	カ ka	サ sa	タ ta	ナ na	ハ ha	マ ma	ヤ ya	ラ ra	ワ wa	
イ i	キ ki	シ shi	チ chi	ニ ni	ヒ hi	ミ mi	イ i	リ ri	ヰ (w)i	
ウ u	ク ku	ス su	ツ tsu	ヌ nu	フ fu	ム mu	ユ yu	ル ru	ウ u	ン n
エ e	ケ ke	セ se	テ te	ネ ne	ヘ he	メ me	エ (y)e	レ re	ヱ (w)e	
オ o	コ ko	ソ so	ト to	ノ no	ホ ho	モ mo	ヨ yo	ロ ro	ヲ wo	

Morse code

Morse code is a means of encoding characters (letters, numbers, special characters, punctuation) for rhythmatic transmission by telegraph key over

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Orote Peninsula, Guam, 1944: a company commander of the US 1st Provisional Marine Brigade (predecessor of the 6th Marine Division) talks to his platoon leaders. The company CO, XO, weapons platoon leader, and the three rifle platoon leaders were all on the same radio net with SCR-536 "handie-talkies"– see Plate F. (Photo by W. Eugene Smith/*Time Life* Pictures/Getty Images)

wire, cable, continuous wave (CW) radio, or light flashes. Each character is assigned from one to five specific dots and dashes, known as "dits" and "dahs," a dash being equal in duration to three dots. The code is transmitted with pauses between letters and words: the pause between dots and dashes in the same letter is equal to a dot; the pause between two letters is equal to three dots, and that between two words is equal to seven dots.

The code was developed in the late 1830s by Samuel F.B. Morse (1778–1847), inventor of the telegraph. His first code was more cumbersome, consisting of three- and four-digit numbers with each combination representing a different word, so the receiving operator had to decode messages using a dictionary-like codebook. This system was discarded before commercial telegraph lines were established, and in 1837 each individual character was assigned dots and dashes. What was known as American Morse Code (aka "railroad code") became standard, but in 1865 the International Telegraphy Congress in Paris adopted the International Morse Code, which allowed for additional letters and special characters used in non-English languages. Russia and Japan developed their own unique codes.

By radio transmission Morse can be sent to extremely long ranges, much further than voice transmission, and is usually more "readable" (understandable). It can be manually transmitted at a high speed measured in words per minute (wpm), with an average word being five letters long; a typically trained operator can transmit 10–15wpm, and the record is 35wpm. Operators can usually receive at a somewhat higher speed. A transmission

E VISUAL SIGNALS

This selection illustrates only a few examples of the wide variety of means of visual signaling available, ranging from the simplest flags, through various forms of blinker lights, to colored smoke.

(1) US Army "wig-wag" flags, 2ft square, were issued in red-on-white and white-on-red; only one was used, depending on the terrain background. The 18in-square semaphore flags were used in matching pairs. The Japanese also made much use of signal flags; their standard semaphore flags were solid red and white, and with the aid of binoculars the signals could be read from several miles, depending on atmospheric conditions.

(2) British Mance Mk V heliograph. This 19th-century technology, using sun-reflecting or lamp-reflecting mirrors whose angle was flipped in and out of alignment by operating a code-tapping key, was effective in good conditions over 40 miles, and relay chains of them could communicate over hundreds of miles. Heliographs were also used by the Commonwealth, Soviet and Japanese armies.

(3) This small Japanese hand-held lamp was powered by an integral hand-cranked generator in the pouch; its rotating head had red, amber and green segment filters. The US and British armies had larger and more sophisticated hand-held signal lamps – made by e.g. Grimes, and Aldis – with colored filters and peep-sights, powered by battery packs or attached to vehicle electrical systems.

(4) The US M-277 "signal gun" was provided with a lightweight tripod as well as a shoulder stock, and a J-51 handkey to tap out Morse signals as well as the basic hand trigger for "blinker" signalling.

(5-8) Colored smoke grenades:

(5) British No.77 Mk I white phosphorus, used from 1942 and officially adopted in February 1943. The Mk II, filled with titanium tetrachloride, showed a flat base, a red filling band and a white stripe. Both used the "Allways" type fuze under a screw-off black Bakelite safety cap.

(6) The British No.83 Mk II of 1944 came with red, yellow, green or blue smoke compounds.

(7) The British No.83 copied the M6 striker mechanism of this US M16 of 1943, available in red, orange, yellow, green, violet, blue and black.

(8) The M16 continued in use alongside this M18 of 1944; externally identical, it provided denser and more vivid smoke in red, yellow, green and violet only.

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Heldon, Netherlands, February 3, 1945: an American SCR-694 battery-operated generator photographed in a British or Canadian trench. The Canadian WS No.58 radio was a development of the British No.18 that was used as a ground set for battalion-to-battalion communication, when it needed an external power source rather than relying on the usual dry batteries; in all armies these had an uncertain "shelf-life" and short endurance. The No.18, 38, 58 and 68 sets could be powered by the British 1942 Power Supply Unit No.5, a vibrator unit with a 6-volt accumulator that in turn had to be charged by a hand-cranked generator, but this was an unpopular item not much used on the battlefield. (IWM B14350)

could be recorded, and then transmitted at a higher speed with experienced operators "copying" at speeds of 40wpm and more. An individual telegraph operator's "hand" could be recognized by other experienced operators; they could not know who he was, but recognized his subtle individual characteristics of keying. This was valuable to radio-intercept operators when identifying a station even if frequencies had been changed. It was also useful to confirm if an operator such as an agent in enemy territory had been compromised and substituted.

Learning Morse code was a basic requirement for radio operators in all armies. Morse can effectively be learned in about three weeks, but at least six to eight additional weeks, interspaced with other communications-related training, are necessary to adequately increase speed and proficiency.

Times and dates

Military operations spanned time zones, even the International Date Line, so a standard means of providing a common time was needed in order to prevent what could be fatal confusion.

The Earth is divided into 24 "one-hour" time zones; these begin at the Royal Observatory in Greenwich, England, which is defined as zero degrees meridian, Greenwich Mean Time (GMT). The time zones run eastwards from Greenwich. On the opposite side of the world is the 180 degree meridian line passing through the Central Pacific just west of Midway Island; this is termed the International Date Line (IDL), where the new day begins. There are thus always two different calendar dates on the Earth, places west of the IDL being one day later. When Hawaii and the Philippines were attacked by the Japanese it was December 7, 1941 on Honolulu but already December 8 in Manila.

The Western Allies used GMT as the standard time for combined and joint operational planning, using the term ZULU Time. East of the IDL times were designated "ZULU minus X hours," and west of the IDL as "ZULU plus X hours." Each time zone was assigned a letter (but I and O were skipped to prevent confusion with numbers "1" and "0"). Since the time zones ran eastward from Greenwich, zone ABLE covered most of Germany. The actual time zones – in theory 20 degrees of longitude or one hour wide – in fact varied greatly, and often followed political and administrative boundaries. There could be an hour's difference between countries in the same time zone, e.g. time zone ECHO in the USSR was GMT minus 7 hours, while in China on its southern border it was GMT minus 6 hours. There were even small special time zones within regular time zones that could be 20 or 30 minutes different from the rest of that time zone. This usually applied to specific island groups, and part of these special time zones might even extend into an adjacent time zone. It is therefore clear that when planning and conducting wide-ranging operations that might span several time zones a common time was essential.

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There was also the complication of Daylight Saving Time, then generally known as Summer Time. In Europe the Allies used British Double Summer Time, or "War Time." This put Britain on the same time as the Continent, with its one-hour time difference plus another hour for Daylight Saving Time. This simplified things for cross-Channel air missions, but in June 1944 it grew dark late, 2330 hours – 11.30pm – since War Time gave 18 hours of daylight in the high summer.

While the Allies used GMT or ZULU Time for a common time reference, the Soviets used Moscow Time (BAKER time zone, GMT minus 3). Germany used Berlin Time (ABLE zone, GMT minus 1), and Japan Tokyo Time (INDIA zone, GMT minus 10); these capitals were where their high commands planned operations, and they thus used local time.

Officially the US Army used the European style of expressing dates, i.e. day-month-year. However, since American civilian practice was month-day-year it was not uncommon for dates to be seen in this manner in US documents. Military time was expressed using a 24-hour clock, 0001 (one minute after midnight) to 2400 (midnight), thus eliminating any confusion over "am" and "pm." From 0001 to 1200 hours (midday) equals 12-hour clock "am" times; to determine "pm" times after 1200 hours simply subtract 12 – e.g. 1300 hours is 1pm, 1800 hours is 6pm, and 2200 hours is 10pm. (In Continental Europe times are usually shown as e.g. 15.00 hours.)

What is known as the Date-Time Group is a precise combination of date and time with the 24-hour clock time preceding the day-month-year, e.g., 060006 JUN 44 was 6am on 6 June 1944. A number might be used for the month rather than an abbreviation. The Soviets used a slightly different system: when indicating friendly actions the time preceded the date, and for enemy actions the time followed the date – e.g. "16.4.45 10.30" would be used to describe a German action at 10.30am on 16 April 1945.

DOCUMENTS

Security classification

The requirements for document security classifications varied; they depended not only on the sensitivity of the information, but were also intended to protect the means of collection, and to prevent the enemy from determining what information was *not* known about him. A classifying authority had to be granted before an individual was authorized to classify a document. The classification was marked conspicuously, on the cover and often on the top and bottom of every page, map, overlay, etc., usually in upper case and sometimes stamped in red. A problem encountered in every army was over-classification, which often prevented documents being seen at the lower echelons which most needed the information.

Documents requiring special handling or which had limited access bore colored or striped covers or were marked to be handled by officers only, or restricted to specific persons; the US used "To be handled by Officers Only," the British "Officer Only," and the Germans *Nur durch Offizier* ("Only by Officer"). Before June 1940 the British used the antiquated "This document is not to be taken into front-line trenches;" it was then replaced by "Not to be taken forward of divisional headquarters," which was discontinued in 1942. There were also special classifications for particularly sensitive signal-intercept materials such as Ultra, Bigot and Magic, but these kinds of "eyes only" materials were never seen at tactical levels. Anything even remotely related

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to signal intelligence, intercept, monitoring, and code-breaking was highly classified; intelligence disseminated to tactical echelons never gave an indication of how it was obtained or its source, and one did not ask.

Document security classification grading – highest to lowest				
United States	**Britain**	**Soviet Union**	**Germany**	**Japan**
Top Secret[1]	Most Secret[2]	*Sovershenno Sekretno*	*Geheim Kommandosache*[3] (Secret Command Case)	*Gunki*
Secret	Secret	*Sekretno*	*Geheim*	*Gungokihi*
Confidential	Confidential	*Konfidentsial'no*	*Vertraulich*	*Gokuhi*
Restricted	Restricted	*Dlya Sluzhebnogo Pol'zovaniya* (For Official Use)	*Nur für Dienstagebrauch* (Only for Service Use)	*Hi, Bugahi*

Notes:

1. The US had no such classification prior to the war. There was confusion with British "Most Secret" documents passed to the US, since to American ears these might be assumed to mean "Almost Secret", and were sometimes released to the media.

2. The British classification "Very Secret" was sometimes used early in the war.

3. Other higher German special security classifications included *Hochtsgeheim* (Highest Secret) and *Strengeheim* (Strict Secret).

Message center operations

The signal element of a regiment or battalion established a message center (British and Commonwealth, signal office; Russian, *uzel svgzi*; German, *Meldesammelstelle* – message collection station). This would be immediately adjacent to the unit command post; another, smaller message center might be established to support an alternate or rear CP. The element operating the radios linked to higher and subordinate units was often co-located with the message center. While the unit signal officer was responsible for the

F BATTALION RADIO NETS, 1944: US INFANTRY & GERMAN GRENADIERS

The US infantry battalion was well equipped with radios by 1944. A jeep-mounted SCR-284 linked the battalion command post with the regimental CP. Each rifle company and the heavy weapons company was allocated an SCR-300 **(inset 1)** to communicate with the battalion command SCR-300. The battalion CP also had a second SCR-300 for special uses (not shown in this diagram). Each company CO and XO, each rifle platoon leader and the weapons platoon leader had an SCR-536 "handie-talkie" for intra-company communications **(inset 2)** - here, for simplicity, only Company B's SCR-536s are indicated. The battalion heavy weapons company had three SCR-536s in the company HQ for the CO, XO and a spare (not shown); and the two machine-gun platoons and the mortar platoon had one each.

By stark contrast, the German counterpart battalion had only four Torn.Fu.d2 back-packed "Dora" radios, operated by three-man radio teams (*Funk-Truppen*) of the battalion's signals section (*Bataillons-Nachrichten-Staffel*); a fifth team was attached from the regimental signals platoon (*Regiments-Nachrichten-Zug*) for direct communications between regiment and battalion. The battalion's four sets might be employed either: one with each of the three rifle companies and one at the battalion CP; one radio with each of the two forward companies and the other two at the battalion CP; or – as here – one with each of the two forward companies, one in the battalion CP, and one with the battalion forward observation post **(inset 3).**

Not shown in either battalion diagram are the radios used by attached artillery forward observers and other attached supporting units.

MAP SYMBOLS

Each country had very different systems for indicating units, installations, activities, and other information via tactical map symbols. There were hundreds of such symbols, and the subject is beyond the scope of this book, but it may be of value to know the means used for identifying friendly and enemy forces. The US and Britain used blue for friendly units and red for enemy; if only one color was available, e.g. black or pencil, then, since unit symbols were indicated by a rectangle, enemy units had an outer box drawn around them. The Soviets used red to indicate friendly rifle, armored, and rear services, but black for friendly artillery, antitank, engineer, and other supporting troops, while the enemy was marked in blue; again, if only one color was available, enemy forces had a double-line around the symbol or were highlighted in some other way. The Germans used black for friendly and red for enemy, but the Japanese the reverse.

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Inland from Sword Beach, D-Day, June 6, 1944: watched by a Commando lieutenant with a Thompson gun, these British signalers of both 1st Special Service Bde and 3rd Inf Div, probably photographed behind the Queen beach sectors, are using man-pack radios. The kneeling Commando (second from foreground, right) with the thick 6ft rod aerial seems to operate a WS No.46, the Commando/Airborne forerunner of the No.38, whose one serious disadvantage was that it might suddenly make a loud squealing noise. The infantryman behind him appears to have a No.38 set. (IWM B5065)

message center, he was also the unit signal staff officer and had to advise the commander and staff on signal matters, coordinate with subordinate and higher signal elements, supervise his troops, and arrange for equipment maintenance and the issue of signal material. He would thus seldom be seen in the message center, which was normally supervised by the senior NCO in the signal subunit. The center operated 24 hours a day and was worked by two shifts. A well-organized and efficient message center was essential to a headquarters' smooth and timely operation.

Officers and NCOs carried on conversations between units by radio and telephone, but this was not a concern of the message center. Staff sections and subordinate unit headquarters normally kept journals recording important conversations and events. The message center operated a switchboard through which all incoming and outgoing telephone traffic was passed. All written messages and documents sent and received by the unit via messenger passed through the message center, and incoming and outgoing messages were decoded and encoded there if necessary. Messages were recorded in a log listing the originator, addressee, message number, precedence, and time and date received or sent. Messengers without assignments waited at the center to be dispatched. Message center personnel maintained various other communications records and secured classified messages. Their equipment included typewriters, decryption/encryption equipment, and a highly accurate clock to maintain the official time. They were also usually responsible for displaying ground–air marker panels when called upon.

Message precedence

Message precedence is a rating placed on messages specifying the priority of their importance. There was always a danger of messages being over-prioritized, thus slowing the distribution and action process. Some of these ratings were as follows, from the highest to the lowest precedence:

United States	British, from 1943*	Japanese
Urgent	Emergency	Most Urgent
Operational Priority	Immediate	Urgent
Priority	Important	—
Routine	Routine	Ordinary

* Prior to 1943 the British and Commonwealth forces used the sequence: Most Immediate, Emergency, Immediate, Important, Routine (no indication), and Deferred (unimportant). This was confusing, since there was no readily discernible logic to the order of priority, and too many degrees of priority.

COMMUNICATIONS COUNTERMEASURES

Just as radio communications were in their infancy, so too were signal countermeasures such as direction-finding, interception, and jamming.

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Radio direction finding (RDF) was mainly used for navigation, and for locating ships at sea and clandestine transmitters. It was not until late in the war that it came into wider use at tactical levels, to locate enemy headquarters and artillery in order to barrage them. Many officers questioned its value in light of the poor reliability of wartime radios, and placed more confidence in older artillery-locating methods such as flash- and sound-ranging.

Communications intercept proved valuable if the enemy's code could be broken, which was usually achieved through operator slip-ups rather than intrigue and espionage. This was conducted at higher command echelons and little was attempted at the tactical level. Some attempts were made by units to monitor local enemy transmissions in hopes of being alerted to imminent enemy actions. At such levels few if any codes were used, and those that were encountered were rather simple; but they were sufficient, in that they could not be broken quickly enough for the intercepted information to be of use in rapidly changing tactical situations.

Jamming, too, was little attempted at tactical levels – low-power tactical radio communications were sufficiently hampered by nature and more powerful enemy and friendly radios. The frequency coverage of radios often overlapped with the enemy's, since there were only so many frequencies available to both sides, and jamming a broad range of frequencies might as easily jam one's own radios. If intercept and monitoring operations were underway, a jamming unit might also be denying an intercept unit the ability to collect information, by jamming the very frequency they were trying to listen in on.

When units were jammed there were several options available. One measure was to simply continue to operate and "talk through it" to the best of their ability, giving no indication that they were being jammed; that way the enemy might give up and try elsewhere in the frequency spectrum. An alternate frequency could be switched to, but this created coordination problems. Typically a unit was issued a primary and an alternate frequency; often they retained the same callsign if forced to switch to the alternate. Alternate frequencies might be used for other reasons than avoiding intentional jamming. There might be too much interference from other friendly or enemy radios using the same band, or atmospheric conditions might make the primary unusable. Fine-tuning the radio might help, as might orienting the antenna or using a different type of antenna. It helped to place hills, ridges, or forests between the jamming source and the transceivers.

Simply moving a radio to a new location as little as a hundred yards away might improve reception on a frequency suffering interference, but it might equally make a previously clear frequency unusable, and selecting a proper radio site was an important aspect of operator training. High ground was naturally preferable, especially for FM radios since they relied on line-of-sight, but was also beneficial for AM radios. Low ground and positions masked from other radios by hills, ridges, and tall trees were the least desirable. Wet soil, marshy and sandy ground all reflect radio waves

In combat, message centers were not so elaborately set up as this one, and the signs suggest that it is being used as part of a US Army demonstration or for training. EE-8 telephones can be seen on both ends of the table, and a message number stamp sits atop the M2 message center clock in front of the counter clerk. See Plate G.

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In the 1940s radio direction finding was still a developing and very specialized art. Here US Army signalmen train on an SCR-206 radio direction finder – a heavy, awkward, and crude device.

poorly. Transmitting from within dense forest and jungle, especially when the other radio is in the same terrain, greatly reduces range and makes for erratic contact. Proximity to power lines, telephone lines, steel-framed or steel-roofed buildings, and large metal objects such as water towers or numerous vehicles can interfere with communications. Thunderstorms were so hazardous to operators that the antennas would have to be lowered and the radios shut down for the storm's duration. Of course, a site that was desirable for reasons of improving radio performance often could not be selected, since it conflicted with the tactical realities at that place and time.

"Radio silence" was a key means of denying information to the enemy or preventing the enemy from detecting an advancing or infiltrating force. When radio silence was imposed on a unit it simply meant that no transmissions were permitted to "break radio silence" unless certain conditions were met. Only the main headquarters could impose or lift radio silence, although it could be broken in certain emergency situations, e.g. the appearance of a threatening enemy force or aircraft. Once engaged with the enemy, regardless of who initiated the action, a unit could break radio silence. Selective radio silence might be imposed on certain units, such as reinforcing infantry, armor, and artillery, so that the enemy would not realize they were present. Other units might continue their routine traffic; the sudden imposing of radio silence pending the launching of an attack could alert the enemy that something was afoot. Regardless, units limited radio traffic as much as possible to deny the enemy information, hamper interception and direction-finding efforts, and simply to conserve their batteries.

Another security measure was for units to change frequencies. Ideally this was done daily, and typically at midnight. Such a frequent allocation of new frequencies and callsigns to hundreds of units required a great deal of effort in coordinating, preparing, and distributing the information in daily signal instructions, and sometimes it was not possible in the heat of combat. An enemy intercept element monitoring a specific unit would probably simply find that a different unit was now on the frequency it was monitoring, but it might not be in proximity to its area of interest. The intercept element would have to undertake a meticulous and lengthy effort of scanning through all frequencies available on the type of radio the targeted unit was using, to monitor and access the traffic on each frequency before identifying the targeted unit.

SIGNAL UNITS

Divisions were assigned a signal company, or a battalion in the British, Commonwealth and German armies. The divisional signal unit typically operated radio, telegraph, and telephone systems in support of the division

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Identifying signal troops

The means of identifying signalers by their insignia varied greatly from army to army. In the **US Army**, Signal Corps personnel (the "commo man," "sparks," "buzzer," "flasher"), and all other troops assigned to an actual signal unit regardless of their job specialty, wore the crossed semaphore-flags-and-vertical-torch branch insignia on service uniform collars; officers' branch insignia had the flags enameled red and white. The Signal Corps branch color was orange; this was displayed as piping on enlisted men's garrison caps, and as the field of battalion colors and company guidons. Signalmen assigned to other units, such as infantry regiment and battalion commo platoons, wore that unit's branch-of-service insignia; there was no way to identify them as signalmen. Marine Corps signal personnel appeared no different from other Marines.

Personnel of the **British Army's** Royal Corps of Signals (R Sigs), created in 1920 by splitting signal units off from the Royal Engineers Signals Service, were identified – like all British branches of service – by a distinguishing "strip" of cloth ⅜in wide × 2in long worn on both upper sleeves of battledress uniforms below the formation insignia; for the R Sigs it was halved dark blue (worn foremost) and white. Officers' woven epaulet rank insignia (pips, crowns) were edged with dark blue. On battledress all ranks wore an arc-shaped shoulder title "ROYAL CORPS OF SIGNALS" in white on dark blue. Signals personnel while on duty in signal offices (message centers), dispatch riders, signals officers, NCOs of other arms employed in message centers, and signals construction and maintenance personnel were supposed to wear a dark-blue-over-white armband on both sleeves, though this was seldom seen in combat zones. The signalers – "sigs bashers" or "sigs wallahs" – were more generally called "Jimmy." This was derived from the figure of Mercury, the Roman god of messengers, displayed on the R Sigs cap badge, which was referred to as the "Signals Jimmy." (This is variously attributed to a contraction of the name of the Italian sculptor Giambologna who created the statue that inspired the badge, and to the fact that a famous Corps boxing champion in the 1920s was named Jimmy Emblem.) Signals-qualified enlisted personnel in other branches such as the infantry and armor wore a cloth badge of blue and white-blue-white crossed flags centered on the lower left sleeve or, for some NCOs, superimposed at the top of rank chevrons.

Like the personnel of all **Red Army** technical branches, signalmen displayed black collar tabs, in their case with blue piping, plus black piping on the uniform and caps and a black service cap band.

German signals troops (*Nachrichtentruppen*) of both the Army and the Waffen-SS displayed lemon-yellow piping and (initially) embroidered unit numbers on their rank epaulets, and officers had lemon-yellow cloth shoulder-cord underlay and uniform piping. (Prior to 1936 the branch color had been light brown.) Signal personnel assigned to infantry and other units wore a cloth oval insignia on the upper left tunic sleeve; this Signals Personnel Badge (*Nachrichtenpersonal-Abzeichen*) was usually dark green, but could be of another color if worn on other than a field-gray uniform; it displayed a point-down lightning bolt in the unit's appropriate *Waffenfarbe* branch color. A radio operator was known as a *Funker* (derived from *Funke* – spark), and a telephone operator as a *Strippenzieher* (line-plugger).

Japanese signal soldiers (*tsū shinhei*) and signal officers (*denshin*) were part of the Engineer Troops (*kōhei*). In 1941 an Inspectorate of Communications was established, making signal troops a semi-autonomous branch but still part of the Engineers. Signal units wore Engineer distinctions, which included a purple "spread M"-shaped cloth insignia above the right breast pocket (discontinued after 1940). Japanese signal troops were referred to as *imozuru* – "sweet-potato vines," alluding to telephone lines.

headquarters and staff elements, and its personnel served with the main, alternate, and rear CPs. They often provided radio teams to the division's subordinate units, and operated the division CP message center. Besides the division's own units they also maintained contact with higher headquarters (corps), adjacent divisions, and supporting units. They usually had some degree of equipment-repair capability, and might or might not provide signal material supplies to divisional units.

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A wide variety of skills were necessary among signals troops; here a US Army instructor coaches a student in making intricate repairs to a multistrand cable.

Leyte, Philippines, 1944: a US Army switchboard operator at a 32nd Inf Div regimental command post watches over two 12-line BD-72 switchboards connecting him to the regiment's battalions, support units, and supporting artillery. (© Corbis)

Regiments/brigades and battalions had their own signal platoons or sections to provide similar support to those echelons. The commander of the signal element for any given echelon typically doubled as the unit's staff signal/communication officer.

The details of the signal units assigned to different types of divisions and their organizational changes over time cannot be detailed here, but the

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following examples are provided for a basic understanding of their organization and roles.

The **American** infantry division signal company was a 230-man unit consisting of the company headquarters, the headquarters platoon (administration, mess, repair, supply, transportation), construction platoon (erecting telephone lines), operations platoon (message center, motor messengers, radio, telephone and telegraph operation), and the division signal officer section (signal staff). US regiments and battalions possessed organic signal elements, so attachments from the divisional signal company were normally unnecessary. Signal companies normally bore the divisional number, e.g., 36th Signal Company, 36th Infantry Division.

A **British or Commonwealth** division possessed a 770-man battalion-size unit known simply as "divisional signals," designated with the division's number, e.g. 50th Divisional Signals. It provided signal elements down to infantry battalion and artillery battery levels. Divisional signals was responsible for the maintenance of all radio equipment. It had a small headquarters company, and four companies each having different duties. No.1 Company provided communications support to the division, the three brigade headquarters, and the attached tank brigade. No.2 Company supported the divisional artillery and its artillery regiments. No.3 Company provided communication from the brigades to the battalion headquarters inclusive, the reconnaissance regiment and its squadrons, and the divisional engineer element and its companies. No.4 Company linked the attached tank brigade's headquarters with its battalion-size tank regiments.

Australian troops at Lea, northeast New Guinea, operate a battalion signals office; the officer at right uses an American SCR-536, and beyond the operator inside the rudimentary groundsheet "basha" is what appears to be a No.38 set. In Digger slang used by other troops, men of the Royal Australian Signals Corps were "chooks" or chickens – an uncomplimentary term best not used face-to-face. (Photo by Myron Davis/*Time Life* Pictures/Getty Images)

The Red Army employed female radio, telegraph, telephone, and switchboard operators at regimental and higher levels. (Stavka/Nik Cornish P23)

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During a pre-war exercise by German III Armee Korps troops, a cyclist *Melder* (messenger) delivers a message to a battalion field radio station; depending on the type of unit messengers might also use motorcycles or horses. The exact model of radio cannot be identified from this angle, but note the tall pole antenna rising from the set, the two headsets and hand-held microphone connected to it, and the battery case beside it. Sometimes two men simultaneously transcribed coded messages, to reduce the risk of errors. Here the foreground man displays the "*Blitz*" lightning-flash signals personnel qualification badge on his left sleeve in infantry white, above the rank chevron of Gefreiter. (© Bettmann/Corbis)

Prior to mid-1942 **Soviet** rifle divisions had a 180-man signal battalion. This had a small headquarters company with radio, telegraph, and messenger platoons, plus a wire company to lay wire and operate telephones. It was reduced to a 160-man signal company with little reduction in capability; this had a headquarters, a radio platoon, messenger platoon, three wire platoons, and a telegraph section. The divisional signal company was comparatively small because the division's subordinate units had their own robust signal elements. The signal company usually carried a designation different from that of the parent division.

The **German** infantry/grenadier division's signals battalion had a strength of some 470 men, and bore the parent division's number. While all other divisional units of, e.g., Infanterie Division 65 were designated e.g. 65. Pionier Bataillon, the signals battalion was for some reason designated e.g. *Nachrichten Abteilung der ID 65* ("signals detachment"). It consisted of the battalion staff, a telephone company (partly motorized), a radio company (motorized), and a company-size light signal column (motorized). The telephone and radio companies provided operator teams to the division's subordinate units. The light signal column supplied all signals elements within the division with materials including wire, and also charged batteries and repaired divisional signal equipment.

The **Japanese** infantry division's "signal unit" (*denshintai*) was normally of company size with 170 troops, but some divisions had units up to 240 strong. It consisted of a small headquarters, two wire platoons, a radio platoon, and a material platoon for repairs and issuing signal supplies. Signal units carried their parent division's number, e.g., *Dai 4 Denshintai* – "No.4 Signals Unit."

Corps and armies of all nations were assigned a signal battalion or regiment, plus numerous small specialized signal units, repair and supply units, and signal construction units.

Infantry regimental and battalion elements

The signal platoons and sections of these units had similar duties and operated in a similar manner. Their primary roles were to provide telephones to the unit's staff elements and wire links to the subordinate units (battalions or companies), and also to fire-support units and adjacent units. They also provided radios to subunits, but usually not enough radios were allotted to provide one to each subunit permanently. The radio teams would accompany

G US ARMY MESSAGE CENTER

A unit's message center (British equivalent, signal office) was a key to successful tactical operations, and required a flexible and responsive staff. It was manned by two teams each pulling 12-hour shifts, who dealt with telephoned and hand-delivered messages. Incoming messages were prioritized, decrypted if necessary, and passed to the proper recipient. Outgoing messages – to be accepted only from known individuals or those showing proper ID – were logged, and forwarded to the addressees by the specified or most expedient means. The standard was to receive and forward a message within two minutes, except for those requiring decoding or coding. This illustration shows the four-man staff of an infantry battalion message center of 29th Infantry Division, equipped with EE-8 field telephones. **(1)** The message center chief, here a Tech 5. **(2)** The counter clerk, with an automatically advancing number stamp, logged the messages. **(3)** The messenger dispatcher assigned messengers and received messages from them. **(4)** The code clerk encrypted and decrypted message traffic as necessary.

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US Army infantry regiment communication platoon		
Platoon HQ	4 personnel	
Message center section	8	
Wire section	20	2 switchboards, 12 phones, 4 telegraph sets
Radio & visual section	17	8x SCR-300, 6x SCR-284
US Army infantry battalion communication platoon		
Platoon HQ	2	
Message center section	7	
Wire section	8	1 switchboard, 8 phones, 1 telegraph set
Radio & visual section	6	2x SCR-300, 1x SCR-284
US Marine Corps infantry regiment communication platoon		
Platoon HQ	5	
Message center & messenger section	12	
Wire section	19	Equipment not specified,
Radio, visual & panel section	24	similar to Army
US Marine Corps infantry battalion communication platoon		
Platoon HQ	3	
Message center & messenger section	8	
Wire section	14	Equipment not specified,
Radio, visual & panel section	15	similar to Army
British infantry battalion signals platoon		
Platoon HQ	4	
Signal office & line section	12	1 switchboard, 12 phones
Wireless section	20	16x No.18 and/or No.38 radios
Soviet rifle regiment signal company		
Company HQ	11	
HQ platoon	9	
Radio platoon	9	2 radios
Wire platoon	21	8 phones
German infantry regiment signals platoon		
Platoon troop (HQ)	3	
Light telephone troop	3	2 phones
Medium telephone troop (x2)	5	1 switchboard, 4 phones
Radio troop (x4)	4	1x Torn.Fu.d2
German infantry battalion signals section		
Section troop (HQ)	2	
Light telephone troop (x2)	3	2 phones
Radio troop (x4)	4	1x Torn.Fu.d2
Japanese infantry regiment signal company		
Company HQ	14	
Wire platoon		
Platoon HQ	2	3 switchboards
Wire section (x5)	12	3 phones
Radio platoon		
Platoon HQ	2	
Heavy radio section (x5)	8	1x Type 94 No. 5 radio
Light radio section	14	12x Type 94 No. 6 radios
(Other than messengers, there was no signal element in the Japanese infantry battalion)		

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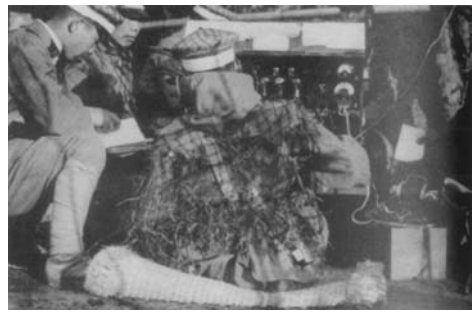
the subunits that were in the forefront of the assault, in the front line when in defense, or conducting temporary independent operations such as raids or reconnaissance-in-force; they might also accompany patrols with back-packed radios. They linked artillery forward observers and observation posts with artillery and other supporting weapons subunits, including organic mortars, infantry guns, and antitank guns.



ABOVE
Again during a pre-war exercise (note the white "maneuvers" cap bands), Japanese troops of the 7th Infantry Regiment operate a base station. Note too the camouflage netting, and the rice straw mat insulating the operator from the cold ground.

UNIT COMMUNICATIONS SYSTEMS

Most armies organized their units in a basically triangular structure – three squads in a platoon, three platoons in a rifle company, three rifle companies in a battalion, three battalions in a regiment/brigade, and so forth. Some armies had more than three maneuver subunits at some echelons; and there were of course other elements such as a headquarters, fire-support units, and other supporting subunits. In regards to unit communications systems, accommodation had to be made for attached elements.

Tactical communications systems ("nets," "circuits," "loops") were organized identically to the normal chain of command. Subunits within a given echelon could only talk to each other and their headquarters; they could not talk to other units outside of their unit's "net," either by radio or telephone. To provide an example, both radio and telephone, we may summarize as follows the **US infantry battalion's** telephone and radio nets down to platoon level.

There was not much to the telephone net. Each of the companies had only two TS-10 sound-powered telephones and a half-mile of wire. This could only link the company CP with either one rifle platoon, the mortar section, machine gun section, or an outpost. Alternatively, on order, it would link the company and battalion CPs. The battalion communication platoon had eight each sound-powered and EE-8 phones with 10 miles of wire. Most of these linked the various elements within the headquarters company, but a line could be run down to each company CP and a phone provided, especially in defensive situations. Army doctrine prescribed:

> The battalion seldom uses more than two telephones, one for the commander and his staff, and one for the observation post. Remaining telephones are used for test purposes and for installation at the new command post during displacement. In a fast moving situation, the

BELOW
A US Army BD-71 field switchboard set up and operational during pre-war maneuvers; this was a six-line switchboard used at battalion level. On the ground is a 1¼-mile DR-4 field wire reel.

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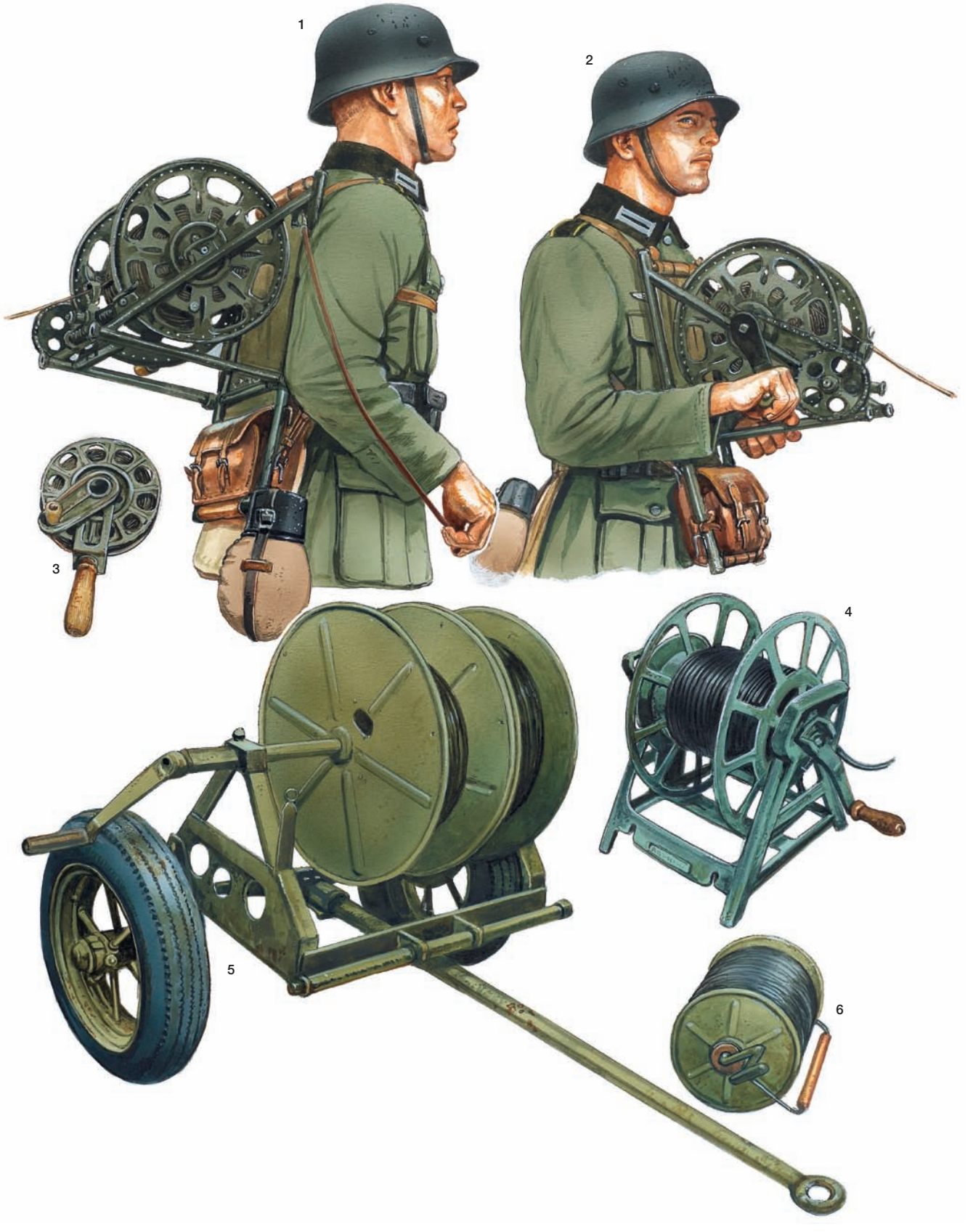

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switchboard may be eliminated at a battalion CP and the telephone connected directly to the line from the regiment. The telephone at the battalion observation post may be connected to this line and form a party line. A switchboard is essential at the regimental CP in all situations when wire communication is maintained to forward elements, but in rapidly moving situations the number of local telephones is usually limited to three, one for the commander and the executive officer, one for the remainder of the staff, and one for the message center. In defensive situations, additional telephones are installed at the regimental and battalion CPs, and sometimes at company CPs.

Messengers were considered the primary means of communications both between platoons and company, and companies and battalion, until radios came into wider use in 1943, and even then messengers were still essential.

Early in the war the SCR-511 "pogo-stick" radio was issued to platoons. It was an awkward design and possessed numerous limitations, and it began to be replaced by the SCR-536 "handie-talkie" in 1942. Range was only about a mile; this was sufficient for intra-company communications, but it had limited value for patrols. Since the "handie-talkie" was an AM radio it could not net with any other radio in the battalion; it could only talk to another SCR-536. One was provided to each of the three rifle platoon leaders, the weapons platoon leader, the company CO and XO. All six of these individuals were on the same frequency.

NW Europe, winter 1944/45: a US Army wireman repairs lines broken by an ice storm. He would be using an LC-23 lineman's belt and LC-6 climbing spikes to scale the pole. Wiremen were provided simple hand tools for cutting and repairing wire, and used cloth electrical friction tape and waterproof rubber tape.

H WIRE-LAYING

The tasks of field telephone linemen were endless. Normally working from the higher headquarters down to subordinate units, they had to lay the wire when a unit took up positions, and retrieve it when advancing or withdrawing. They also had to repair the constant breaks caused by shellfire or deliberate enemy action, and by friendly traffic – particularly, tracked vehicles. To conserve wire it was laid along the most direct route possible, but detours had to be made around water obstacles, swamps, and particularly rugged terrain or dense vegetation. Roads were the greatest obstacles, as vehicles were the most destructive threat; if possible wire would be run under roads through culverts or bridges, but if this were not practical then it had to be strung above ground using trees or temporary poles; a height of 14ft was preferred, but sometimes even that would not protect wire from the radio antennas of passing vehicles. Ideally wire would be tagged with a coded unit identification on both sides of a road, especially where multiple wires crossed, to hasten necessary repairs. In some instances, especially in well-established defenses, alternative lines were laid to ensure uninterrupted communications. Burying wire by hand was an impossibly time-consuming and labor-intensive process; it was seldom attempted unless a special wire-burying plow was available, and then only when terrain conditions were suitable. Wiremen were provided belts and pole-climbing boot spikes, as well as long "wire pikes" to aid in stringing lines in trees.

Wiremen used small man-portable reels for both laying and recovering wire, a hand-crank being used in the latter role. Once laid, wire was seldom cut short at its destination; the remaining wire would be left on the reel, since it would certainly be needed in the future.

(1) A German *Drahtzieher* lays 200 meters of wire from a *Kabeltrommel mit Tragegerät* ("cable drum with carrying equipment"), slung on his back for laying. A canvas and leather apron is fitted to the frame to keep the turning spool away from his body, and the narrow leather hand strap operates a brake to keep tension on the cable and prevent it spooling out too fast.

(2) The German wireman recovers cable, with the drum now slung on his chest. The hand-crank now fitted to the near side was carried, with tools, in the leather accessory pouch low on the *Kabeltrommel* frame.

(3) A small German two-hand reel was also available for shorter runs of cable.

(4) German cable reel on a fixed ground stand.

(5) US RL-35 cable trailer, either towed behind a jeep or hand-drawn by two men. Fitted to the carriage is an RL-31 cable reeler with two DR-4 wire reels each carrying 1¼ miles of cable.

(6) The US DR-8 hand reel, with ¼ mile of assault wire, was used at company level. (The DR-4 and DR-8 reels are still in use today.)

US, British, Commonwealth, Soviet and German field wire was black, but Japanese was yellow. They reasoned that wire, regardless of color, was difficult to see from the air, and believed that it was more important for it to be easily followed by their own repair parties, especially at night.

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The battalion communications platoon allotted an SCR-300 to each company headquarters, which had to provide the operator. The three rifle company CPs and the weapons company CP were all on the same FM frequency and linked to an SCR-300 with the battalion CO. The battalion CP communicated with the regimental CP with an SCR-284, which was an AM set.

The **British** employed the WS No.18 in broadly the same way as the US practice with the SCR-300, but were rather spotty in their issue of radios at platoon level, depending on availability and command practices (though they might be more generously provided to Airborne and Commando subunits). Often it was felt that detailing radios and operators to platoons, where they typically suffered high casualties, was a waste of highly trained individuals and valuable equipment. It was not until late in the war that No.38 sets were routinely issued to some rifle platoons. The following extract from the 1945 *Signal Tactics – The Infantry Battalion* describes the allocation of the battalion's WS No.38 radios from the signals platoon:

> No.38 sets: A band of frequencies is normally allotted to the battalion for its No.38 sets. The signaling officer allots frequencies from this band to sub-units as required, taking care that adjacent frequencies are allotted to sub-units as far away from each other as possible. The band is usually wide enough to provide four or five separate frequencies. One should be given to each rifle company as required, at least one to the mortar platoon, and one to the [Bren gun] carrier platoon. The sets are worked by non-signal personnel and are on the charge of the sub-units. Their employment is not the direct responsibility of the signaling officer, but he should, as representative of the commanding officer, maintain control over the grouping of these sets to the extent that they affect his signal plan as a whole. For example, they may be made to provide direct communications between two sub-units, or to reinforce important No.18 set links. Again, the signaling officer in conjunction with the CO will decide which (rifle) companies, if any, will have No.38 sets down to their three platoons.

Enterprising wiremen in the Philippines lay wire from ¼-mile DR-8 cable reels attached to packboards slung on a hired *carabao* water buffalo.

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This is probably a British brigade-level operator, makings telephone connections with a pair of ten-line "universal call" switchboards. They lacked an "operator pack" and required a separate field telephone – here placed atop the nearer switchboard – to provide the operator with a handset.

> Great economy should be used in the actual use of No.38 sets, owing to the short life of their batteries.
>
> The basic sub-allotment of No.38 sets has been taken as – 2 to each of the four rifle companies; 6 to the carrier platoon; 10 to the mortar platoon; 4 sets in pool.

Another possibility was for the "main effort" company to have four sets, one with each platoon and one with the headquarters, while the other three rifle companies had the normal two-set allocation.

The **German** infantry regiment's signals platoon (*Nachrichten-Zug*) had four man-packed "Dora" radios (Torn.Fu.d2). Typically one was assigned to the headquarters of each of the forward battalions, one to the regimental HQ and the other to the regimental observation post. The infantry battalion's signals section (*Nachrichten-Staffel*) also had four "Dora" sets. They might be allocated with a set accompanying each of the two forward companies and in direct contact with paired sets at the battalion headquarters. An alternative was three sets with the three rifle companies, or two with the two forward companies, the third with the battalion observation post or another important element, and the fourth at battalion headquarters.

In theory the **Japanese** regimental signals company had 12 back-packed radios, usually with two allotted to each battalion, one of which would accompany the battalion commander and the other remaining at the regimental headquarters for direct contact. Other radios might accompany the regimental infantry gun company, and observers would have the others. These would be backed up by telephones, which would be used in preference to the radios, which would normally be employed only during the advance or pursuit.

CONCLUSION

World War II was the first war in which radio communications played a major, even a dominating role. Radio communication was essential and critical at all echelons in a global war. Strategic decisions, orders, and

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Bokstal, Netherlands, October 25, 1944: part of the command group and a rifle section of a British infantry platoon pause under cover behind a building during the attack by 51st (Highland) Division. Behind the platoon sergeant (who, unusually, seems to hold a semi-automatic pistol), the platoon radioman carries a No.38 set. (IWM B11280)

coordination were transmitted, and sometimes intercepted and exploited, which changed the course of the war.

Communications via radio, telegraph, telephone, and visual means were no less critical at the tactical level down to the smallest fighting elements. The advent of lightweight man-portable tactical radios proved to be extremely beneficial. It ensured that orders, intelligence information, and situation reporting was accomplished in near-real time, and supporting fires could be requested and adjusted at high speed. Field telephones were no less important, often being the primary means of tactical communications, and telegraph was more widely used than many realize. Due to the significant post-war improvements in radios – especially with automatic encryption and satellite communications – telephones and telegraph have largely fallen by the wayside in the intervening generations.

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A German telephone operator transcribes a message from an artillery unit to pass on to a messenger. Note the *Feldfernsprecher 33* field telephone, and, beyond the messenger's helmet, a *Kabeltrommel mit Tragegerät für die Nachrichtentruppe* (cable reel with carrying equipment for the signals troops) – see Plate H. (© Hulton-Deutsch Collection/ Corbis)

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In a slit trench at a frontline company command post, a German signalman talks to an outpost on a field telephone. (Stavka/Nik Cornish WH933)

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World War II Battlefield Communications

The development of practical, man-portable radio sets for communication between companies and battalion headquarters, and later between platoons and companies, was central to the character of World War II infantry fighting. It enabled units to employ flexible, coordinated tactics, allowing their commanders to exploit success, call in supporting fire, or limit the costs of failure. However, the new man-pack radios were still immature and infantry commanders also had to employ other means, from wire-linked field telephones to the most basic of all – a soldier carrying a message. This concise guide to a vital and fascinating aspect of World War II tactics explains the equipment and practice of the US, British, Soviet, German, and Japanese armies. It is illustrated with many wartime photos, and with color plates showing everything from telephones and radios to flags and flare pistols, and how they were used.

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